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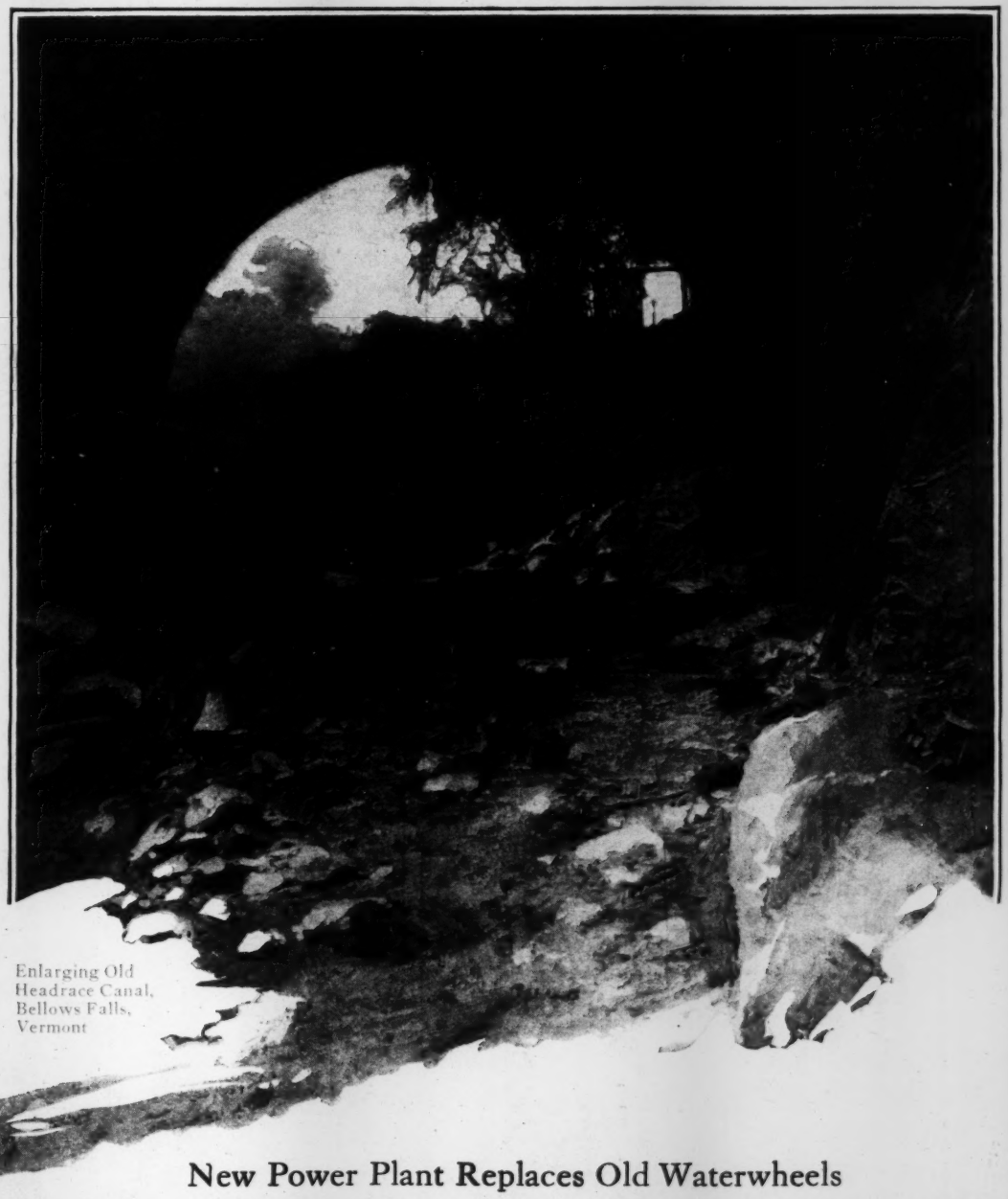

Enlarging Old Headrace Canal, Bellows Falls, Vermont

New Power Plant Replaces Old Waterwheels

Foundation Problems in Enlarging the Center Pier of a Swing Bridge

Winter Construction of Road Bridges in Michigan

Today in the Mississippi Flood Area—Third of a Series of Articles

Staff Report of Asphalt Paving Conference and Annual Meeting of Highway Research Board

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Coolidge on the Mississippi

TAX reduction and control of the Mississippi River are the most important, because the most immediate, subjects to come before the new Congress, which meets this week. But while taxes can be acted upon conclusively, there is no possibility of dealing thus with the Mississippi, since not enough is yet known about the problem. Engineering methods are poor subjects for decision by a legislative tribunal at best, and pre-eminently so while the facts are only imperfectly known and while there exist such violent beliefs this way and that as in the case of the Mississippi. But the matter of paying for the work that must ultimately be done can and possibly will be prescribed by the present Congress. And this is a momentous question indeed, in both its present and its ultimate effect. Hence the exceptional importance of what President Coolidge said on the subject in his annual message. He mentioned, first, the existing law, under which the nation has paid for two-thirds the levee work and the local land owners only one-third, and he pointed out the special favor which this arrangement accords to the Mississippi River flood lands. He then says: "It is true, of course, that the troublesome waters do not originate on the land to be reclaimed but it is also true that such waters have a right of way through that section of the country and the land there is charged with that easement. It is the land of this region that is to be benefited. To say that it is unable to bear any expense of reclamation is the same thing as saying that it is not worth reclaiming." Here is an admirably sound statement of principle. Specifically he suggests the following plan: "Because of expenses incurred and charges already held against this land, it seems probable that some revision will have to be made concerning the proportion of cost which it should bear. But it is extremely important that it should pay enough so that those requesting improvements will be charged with some responsibility for their cost." And he adds a little later the sententious observation that "The government is not an insurer of its citizens against the hazard of the elements." Mr. Coolidge has laid down an excellent doctrine to guide future thought on flood protection.

A Congressman Differs

IN SHARP contrast with the presidential analysis of Mississippi River control responsibilities is the pronouncement by Congressman F. R. Reid, Illinois, chairman of the house flood control committee which has been holding hearings on the subject for a month. He asserts in a public statement on the hearings that "The control of the destructive flood waters of the Mississippi River is a national duty to be recognized by the federal government." He speaks favorably of Congress assuming responsibility for the future control of Mississippi floods, and makes it clear that this should include not merely devising and executing but also paying for the works: "The control of these disastrous floods is just as much of a national duty as is the improvement of rivers for navigation." He ignores the natural easement resting upon the flood basin lands, which the President points out in his message, and finally makes the poverty plea, historically resorted to in all efforts to obtain public money for local benefits. "Nearly every levee district is bankrupt," he says, "and cannot raise the money to protect the lives and property of the people living in the area subjected to overflow. Consequently, the federal government must do it." In these remarks there is an unpleasant forecast of the charity attitude which Congress may take toward the complex Mississippi problem. The saving feature of the case is that the congressman comes from a state which has long sought to have the government devote largely increased moneys to the improvement of the Mississippi, and so perhaps his words may be discounted as having a bias of personal interest.

The Colorado River Puzzle

ONLY a few non-committal sentences in the President's message were devoted to the development of the Colorado River, which for some years has been one of the most troublesome problems before Congress. But he referred to the report of the Secretary of the Interior for fuller discussion, and here we find certain significant statements. It will be remembered that during two years the only development plan offered for consideration, the Boulder Canyon dam project, has failed to make headway because of the existence of the interstate Colorado River Compact and its incomplete ratification. Most of the states feared to have the project approved because of its possible interference with what they thought to be their rights and privileges; but, while Colorado believed its claimed rights would be protected by the compact, Arizona considered that the compact would deprive it of water and was not willing to consent to this unless accorded the right to collect power royalties from the federal development. During the past summer and fall several long conferences between the governors have been held, so far to no effect. Referring to this phase of the matter, Mr. Work says in his report: "The problems are so numerous and varied that interstate and international compacts or treaties were deemed advisable. Such compacts have not been finally consummated. In fact, at present writing contentions are made by some which, if maintained, might leave the federal government without reason to expend further time and money in connection with the project. If the rights and privileges incident to such projects are purely local and intrastate, there would appear to be no warrant for the expenditure of federal money for its construction." These pointed words carry a sober meaning. The project is, in fact, of purely local

kind, having a vital interest to the seven states of the river basin but none whatever to the rest of the country —except in so far as proper utilization of any great stream in its domain concerns the whole nation. The financial and initiative responsibility for the Boulder Canyon or any other development of equivalent purport on the Colorado is plainly a matter for the abutting states themselves. Only one argument can be made for federal action and financing, namely—that the states do as a matter of fact lack the initiative and financial sense to discharge their responsibility. It were better if the problem could be left to their care. As it is, Mr. Work's statement invites thought. The situation that has developed is indeed such as to raise doubt whether the United States should not abandon further effort to carry the project forward.

Blind Calls for Bids

UNIFORMATIVE proposal advertisements are fewer than they were five years ago but still too many for the good of the construction business. For a long time this journal has printed often in its pages of proposals for bids for construction a call for advertisers to make their requirements full and definite enough for the prospective bidder to determine from the advertisement whether he was able to or might have a wish to undertake the work. Most private corporations and individuals now do this. In general it is done by directors of municipal public works. A few agents of the public, particularly the federal government departments and some state public works departments, continue not to do it. The result is utterly wasteful; the public does not secure the competition of bidders which it might secure and contractors are put to unnecessary expense to find out whether or not they wish to compete in the bidding. Any advertisement asking for bids for construction should tell the contractor enough for him to know whether the work fits his experience, plant, organization and ability to finance. If it does not the contractor may not care enough to write, or to travel to find out, and if he does go to these expenses they are entered into his overhead costs and ultimately the public pays them.

Redeveloping an Old Power Site

ONE by one the old mill towns clustered around the waterfalls of the rivers of our eastern states have undergone a radical change, a modernization of the power resources which first attracted industries to the site. Sometimes this has caused little change in outside appearances, as in the case of Cohoes N. Y., where, save for a lack of swift water in the many old raceways, there is little about the quaint old mills to indicate that hydroelectric generators down in the gorge have replaced the many waterwheels that formerly provided power for the thousands of spindles which still hum within the mills. In other towns, the change is much more evident. Mill buildings have gone into the discard along with their antiquated waterwheels. In such cases, the change usually indicates a change in industry as well as in the method of developing power. Bellows Falls, Vt., falls into this latter class. It is a paper-mill town with mills left vacant by changes in the industry. The redevelopment of its power resources is described elsewhere in this issue. The undertaking is of interest as an example of how such a power plant not only must be adapted to fit the limitations of the site but also can be designed to take advantage of its possibilities such as the abandonment of mills blocking the old power canal. The power house, with its long elbow draft tubes cut out of solid rock, is an especially notable example of adapting the structures to the site.

Ford and the Highway

HENRY FORD'S performance in bringing out his new motor car is not only a nine days' wonder, but at the same time suggests dreams of unexplored possibilities of American industry. Cannot other fields of production by similar means accomplish equally outstanding results?

We refer to substantial achievement rather than to the winning of an amazing volume of publicity for the new car, though this in itself, we must admit, was a superbly managed affair. The new car captured front page space in the most important daily papers, probably the first time that a manufactured product achieved this distinction. Back of this theatrical success were various causes, quite aside from planned publicity: the widespread expectancy due to months of waiting and even more to the magical mystery thrown about the development of the machine, as well as the established position of the old Ford as the car of the masses. Yet these were probably less potent causes for the final intensity of interest than the character of the new car itself.

Great numbers of people believed that a sensationally new design would result from the many months of replanning and retooling at the Ford works; it was hard to conceive that anything less could be the outcome after so huge an industrial organism had been deliberately stopped and then for months kept marking time, at a cost of untold millions. And when at last authoritative statements came out, these expectations were seen to be justified. The new car was found to be good, sensationally good. It appeared that what the ablest minds of the industry had sought in vain was here put forth in full-blown realization, the short, light and efficient car endowed with riding steadiness at all speeds. Evidently the group of people popularly known as Henry Ford had, under the leadership of their patron saint in person, analyzed more keenly the factors of road and driver, of modern motor-vehicle service needs, than had any one else; and evidently, also, they had gone to work with more relentless logic to adapt the machine to those needs. Because of the actual accomplishment, in other words, and only because of this, were the publicity preliminaries rendered of any effect.

How permanent the creation of the new car will prove to be remains to be seen. It will probably not survive unchanged for a dozen or fifteen years as did its predecessor; it may even be surpassed within two years; but in the meantime the machine will find an enthusiastic market, and it promises to leave a lasting impress on automobile development.

Are similar possibilities open in other industries? We suspect that they are. The creation of improvement by keen and far seeing study of service needs, present and future, coupled with persistent effort to develop a product meeting these needs, can accomplish marvels elsewhere than in the automobile field. As the late Frank Gilbreth said more than once, "The way a thing has always been done is most probably the wrong way," an epigram that

may be applied as well to the making of steel or brick or to house building as to the selection of glass for windshields or the placing of buttons on coat sleeves.

Such reflections aside, however, there is a significant item of the new Ford car which concerns the highway engineer. It was long suspected, and now is almost demonstrated by experiment (see the results of Professors Carpenter and Dana on p. 913 of this issue) that the blame for that most abominable highway evil, washboarding, rests mainly on the army of small, light cars with their rapid rate of spring vibration. Softness of springs in relation to weights of body and axle has narrow limitations in this type of car. But hydraulic dampers, as applied to the new Ford, can effectively control the destructive vibrations.

If this device proves as effective as it is capable of being, the effect on highways will be of remarkable importance. Destruction of surface will be reduced, maintenance costs will be decreased, and at the same time thousands of miles of road will automatically be transformed so that they will give riding comfort and pleasure in place of making the traveler miserable at best.

There is a possibility, of course, that the damped oscillations may prove to have their own peculiar harmful effect on the road. Physical actions involving irregular periodic motion often have unexpected effects, and in the highway field there has never been much place for unsupported theorizing. On the face of the matter, however, the outlook is for no bad effects of any moment, so that the lessening of corrugations may be counted a clear gain.

Not only the direct gain is to be considered, but also its indirect effect in giving the gravel road surface a new status. That with reasonable maintenance attention this type of surface is excellent as to service and lowest in annual cost for light traffic volume has long been recognized, but many miles of it have nevertheless been replaced by hard surfacing because it roughened up so quickly through washboarding. When this effect becomes unimportant, the gravel road may hold its position more securely. And, incidentally, proper construction and maintenance methods for gravel will engage newly awakened interest.

Refuse Destructors No Cure-All

REFUSE destructors as a universal cure-all find no favor with the British Minister of Health. At least he has conveyed to the London County Council, states London *Municipal Engineering,* his "doubts whether a public inquiry at the present time," evidently designed to promote the building of destructors, "would contribute towards a solution of the problem of dealing with London refuse." Our contemporary adds that delay will give the councils of the county and boroughs composing the County of London "time to reflect and decide whether the 'cult' for the the erection of dust destructors and their costly means of 'converting' refuse from one state to another is as supportable as some well-meaning but dogmatic enthusiasts believe." As the *Surveyor* well says, refuse destructors leave a large volume of residue for disposal, "generally at great cost." This presumably refers to destructors through which the entire volume of mixed refuse is put, with a resultant 20 to 35 per cent of residue still awaiting disposal.

The attitude of the Minister is all the more significant because the London County Council, in petitioning the minister for a hearing, urged that "the present system of dumping London refuse on the north bank of the river Thames at Hornchurch is a menace to the health of the growing population of the neighborhood." Our contemporary urges that Bradford, England, has a "less offensive" and "incomparably less" costly method of refuse disposal, described in its issues of Sept. 29 and Oct. 6, by means of which that city converts waste land into fertile areas." It states that there are large areas of "marsh and unproductive land within 30 miles of London which . . . whilst swallowing up London refuse for numerous years will at the same time be converted by intelligent and controlled supervision into revenue-producing land."

All the foregoing opinion from abroad is quite in line with the changes as regards refuse disposal that has swept over England since the great war. It does not mean that destructors have been given up there or that incineration should not go on increasing in the United States and Canada. What it does mean is that the subject should be considered broad-mindedly as an engineering problem, to be worked out to suit varying local conditions.

County Road Advance

COUNTY highway management is finding a place in the sun. In the press of organizing and carrying out the improvement of state highway systems there has been scant time to give to secondary roads of county systems and broadly speaking their improvement according to modern engineering standards has lagged. There are exceptions. Counties like Wayne and Cook and Allegheny and many others having smaller but rich and progressive metropolitan districts have county roads which in construction and upkeep are not excelled by the best state roads. Altogether there are many such counties but gratifying as is the number it is small compared with the aggregate of over 3,000 county road systems in the nation. By and large county road work is less well done than is state road work. The reasons for this are not hard to find; it is not necessary to enumerate them here. The important fact is that a change is coming about. There is a growing consciousness of the county road system.

Some indications of this are: The American Road Builders' Association has created an associate organization of county highway officials. The response in membership has been large, organization has been arrived at with notable proficiency and promptness, an admirable program of committee reports and technical papers has been arranged for the annual convention and road show of the parent association in Cleveland next January. This is constructive association work but it does not stand alone. State universities are giving study to county highway problems. Before us is a report of the Engineering department of the North Carolina State College on county highway administration and engineering in that state. The University of Tennessee has made important studies of county highway traffic. Purdue University of Indiana is conducting a survey of county road management economics. These names do not exhaust the possible list of examples but they are enough to establish the point. Altogether there is awakened interest in county road management and it is in considerable measure a well directed interest. The efforts should be multiplied and the work pushed, for beyond question, the need is great.

New Power Plant Replaces Old Waterwheels

Power of Connecticut River at Bellows Falls, Vt., Being Developed in One Power Plant of 60,000 Hp.—Many Waterwheels in Old Mills Built Around the Falls to Be Abandoned

COMPLETE development of the power available in the Connecticut River at Bellows Falls, Vt., is being undertaken by the New England Power Association. Part of the power has been used for many years by waterwheels in a group of mills clustered around the falls. In all, these mills contained some 75 waterwheels ranging in capacity from 50 to 500 hp. They did not begin to use all the power available at the site. The new power plant will develop the full head of from 57 to 61 ft. and will contain three 20,000-hp. hydroelectric units. Most of the old plants are antiquated, others have been abandoned; some have been torn down to make way for the new power plant and others will receive electric power in exchange for their water rights.

The general arrangement of the new development is shown in Fig. 1. A new dam at the head of the falls replaces the old dam in the same location and provides for better control of the pond. The old canal is being deepened and lined, and where it comes out to the edge of the cliff below the falls it is being widened out into a forebay behind a new power house which is set across the end of the canal, forming, in effect, a dam in the canal. Below the power house, the draft tubes are cut down through solid rock into the tailrace, an S-shaped channel roughly parallel to the rapids at the foot of the falls, discharging into the pool below the falls at the point from which the old canal took off. The total head to be developed is 63 ft., an increase of 11 ft. over the possible maximum head of the old layout through the use of crest gates and flashboards on the new dam.

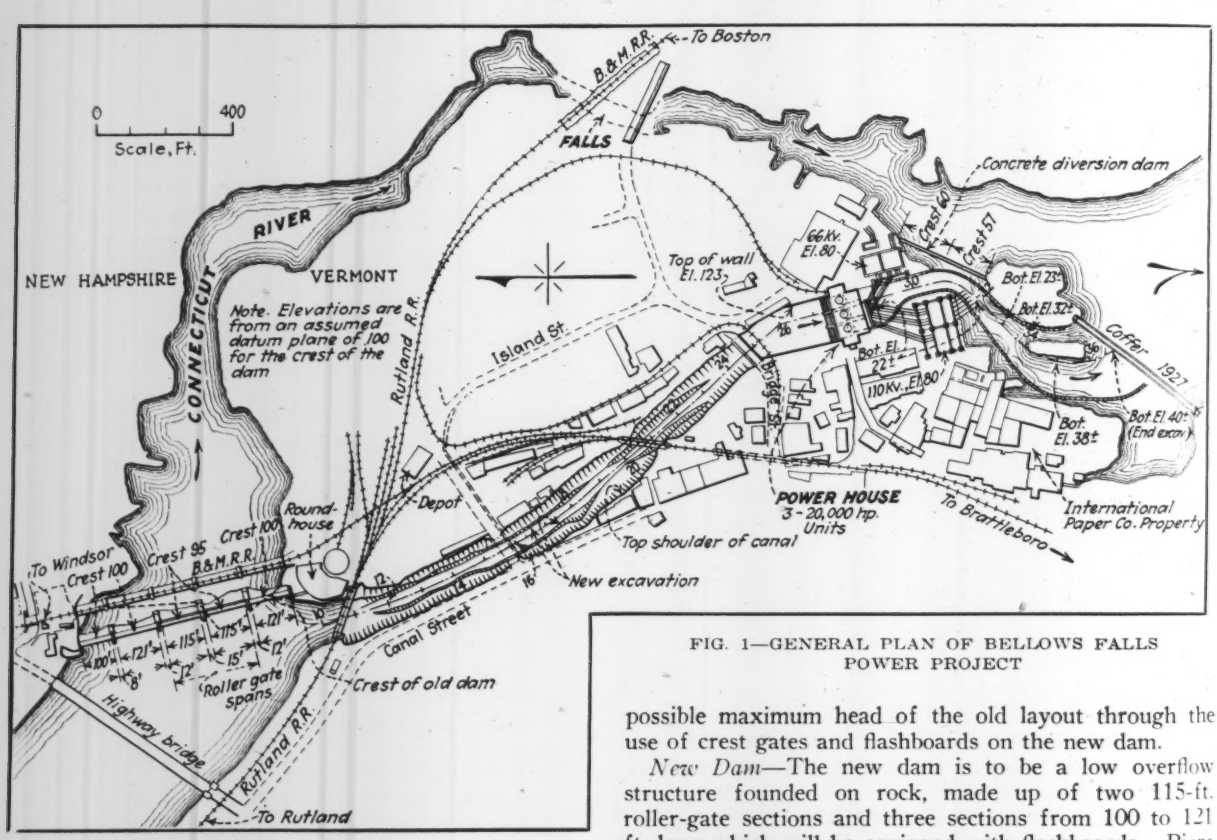


FIG. 1—GENERAL PLAN OF BELLOWS FALLS POWER PROJECT

Between the years 1792 and 1803 a navigation canal was built around the falls. Later, when the railroad came up the valley and diverted traffic from the canal its waters began to be used for power purposes and mills gradually grew up around the lower end, until finally one was built across the canal, completely closing off the channel. In more recent years many of these mills—mostly paper mills—have become obsolete, making it possible to tear them down to make way for the new development; but others still operate and have to be maintained and supplied with power and process water during the period of construction. This condition has complicated the present construction operations considerably.

New Dam—The new dam is to be a low overflow structure founded on rock, made up of two 115-ft. roller-gate sections and three sections from 100 to 121 ft. long which will be equipped with flashboards. Piers between the sections support an operating bridge. The crest of the roller-gate sections has been made 5 ft. lower than the crest of the old dam in order to give a large percentage of easily controlled spillway capacity. Changes to be made in the channel directly below the dam will require the underpinning of an abutment of the Boston & Maine R.R. bridge; and the raising of the pond level above the dam will require the construction of fenders to protect the ends of the nearby highway bridge.

The flashboards are to be 13 ft. high. They will be supported by needle beams let down into cast-iron recesses set into the crest of the dam and having their upper ends held by a mechanism attached to the operating

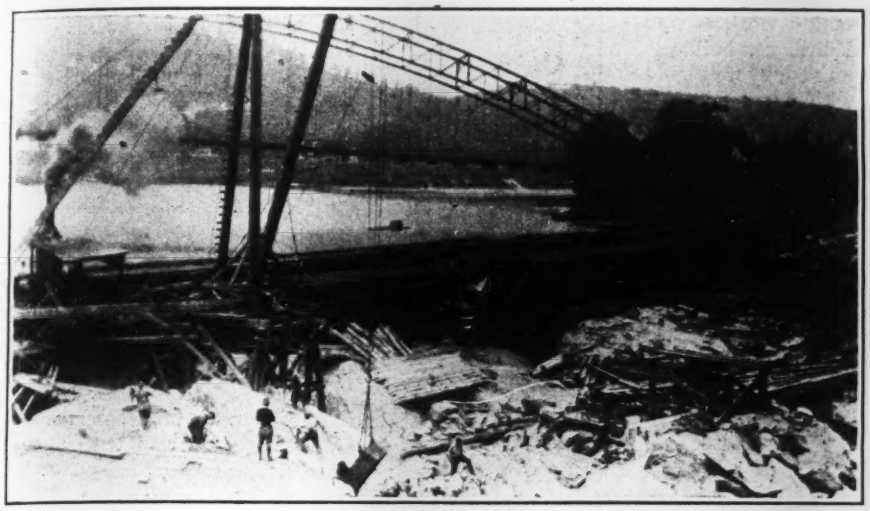


FIG. 2—ROCK WORK INSIDE THE RIVER COFFERDAM

bridge. Normally, these flashboards will be lifted out with a hoist, but they can be released quickly from the operating bridge in an emergency.

Canal—Normal summer flows in the river vary from 3,000 to 8,000 sec.-ft. Spring floods range from 60,000 to 70,000 sec.-ft. The canal capacity is to be 10,000 sec.-ft.

The portion of the old canal which is to be enlarged and used as a headrace is about 1,700 ft. long. Material being taken out in its enlargement is largely glacial, except for some rock in the bottom and at the lower end. As much of this material is of an unstable character, and as the top width of the canal is restricted by buildings through the greater part of its length, the enlarged canal is to be lined except where it is through rock. The sides of the lined portion are to have a slope of 1¼ to 1 except for a vertical wall between the normal operating levels. The lining is to be a paving of one-man stones or larger, reinforced at 20-ft. intervals by ribs extending from the bottom up to the base of the vertical wall, as shown in Fig. 4.

In this manner, as rock for paving is available close at hand in the canal, and as watertightness is not necessary on account of the character of the adjoining rock formation, a satisfactory lining is being obtained at a minimum of expense.

Widening of the canal necessitates replacing the present stone arches of the Bridge St. crossing. A single concrete arch spanning the entire canal and so placed as to improve the alignment of Bridge St. is to be substituted.

Power House—The power house is shown in section in Fig. 6. It is remarkable in that a very small amount of concrete is required for the substructure, the three turbines being set in a trench excavated in solid rock, and the draft tubes, which are of the elbow type, being cut out of the underlying rock by tunneling. The only concrete required is that for the scroll cases and the lining of the draft tubes. This arrangement not only resulted in a large saving in concrete but also made it feasible to use long elbow draft tubes. The upper end of the draft tubes is protected by a plate-steel lining.

The switch house is at the front of the generator room and the transformers are out in front of it, both on top of the rock cliff through which the draft tubes are excavated. The three switch yards are being built at convenient elevations on the same rock ledge, one a 110,000-kv. yard for the line which will connect with the main system of the New England Power Co. at Pratt Junction, one a 66,000-kv. yard for the line to Vernon to connect with the local system, and a 44,000-kv. yard for power to serve Vermont and New Hampshire territory above Bellows Falls.

The power house contains three vertical turbines direct-connected to electric generators. It is served by a 95-ton crane reaching from a railroad spur at the east end to the transformer track at the west end of the building.

Adjoining the generator room on the upstream side is the intake house, an inclosure for a 50-ton gantry crane which will operate the caterpillar headgates and the power rake on the trash racks. These facilities are housed on account of the climate. The mechanical trash rake dumps into a transverse trash chute which in turn discharges into an ice chute running from one end of the forebay past the power house into the tailrace.

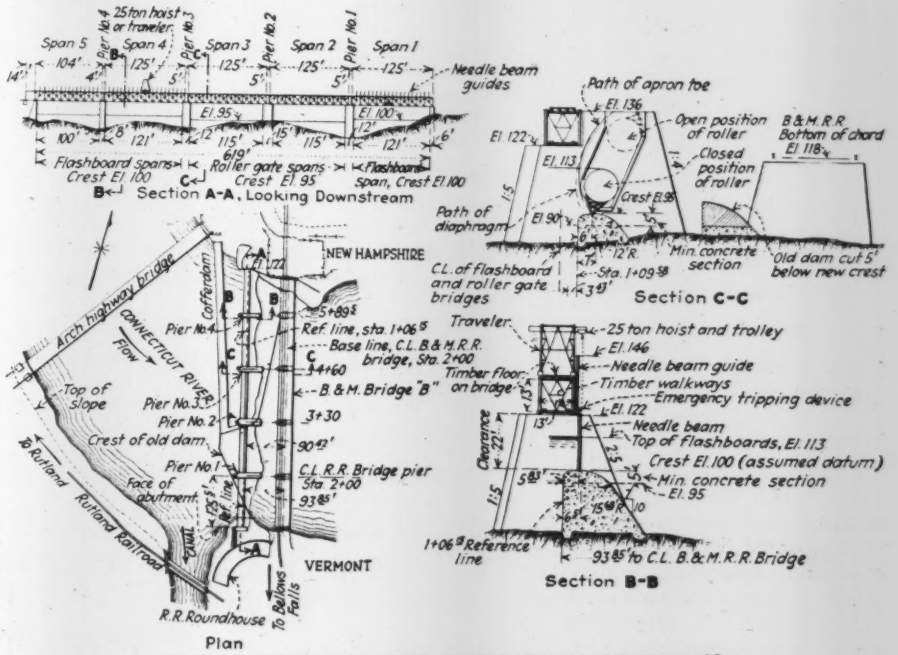


FIG. 3—DETAILS OF THE CONNECTICUT RIVER DAM

Construction Operations—Construction work is complicated by an unusual number of bridges, buildings, streets and railroad tracks to be maintained, by mill buildings and channels supplying them with water from the old canal. The preliminary work of clearing the site of the forebay, power house, tailrace and switch yards of mill buildings in itself was a considerable operation and a large part of the first season was devoted to this work and to reconstructing the west end of the dam.

Work was begun in the summer of 1926. During the fall and winter of 1926-27 rock excavation was carried on at the power house and in the tailrace in order that concrete could be poured in the power house by early spring. The 1927 construction season is being devoted to completing the power house and switch yards, completing the eastern end of the dam, excavating and lining the canal, and excavating the lower end of the tailrace. This latter work is being done in the dry behind a large cofferdam—it is largely glacial drift with some rock—using steam shovels loading directly into trucks for movement to a waste dump on the river bank below the end of the cofferdam. Trucks also are used to haul waste from the canal and forebay. No industrial railways are used except on the dam.

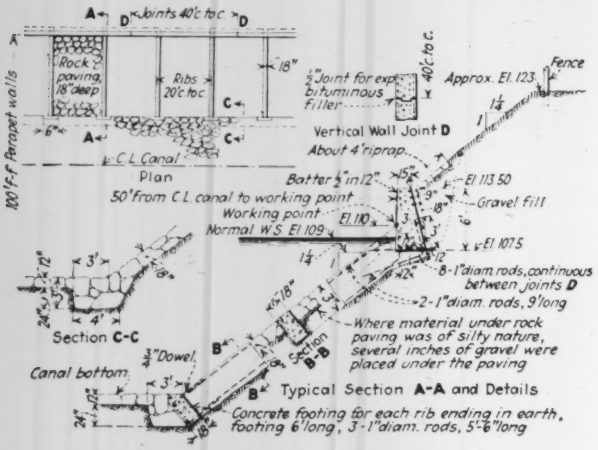

Joints 40'c to c
Rock paving, 18" deep
Ribs 20'c to c
18"
½"Joint for exp. bituminous Filler
40'c to c.
Approx. El. 123
fence
Vertical Wall Joint D
About 4' riprap
C.L. Canal
Plan
100' F-F Parapet walls
Batter ½" in 12"
El. 113.50
Gravel fill
50' from C.L. canal to working point
Working point
El. 110
Normal W.S. El. 109
El. 107.5
8-1" diam. rods, continuous between joints D
2-1" diam. rods, 9' long
Where material under rock paving was of silty nature, several inches of gravel were placed under the paving
Section C-C
¾" Dowel
Canal bottom
Typical Section A-A and Details
Concrete footing for each rib ending in earth, footing 6' long, 3-1" diam. rods, 5'-6" long

FIG. 4—DETAILS OF CANAL LINING

The excavating units used are either one shovel served by three 4-yd. auto trucks or one shovel served by two 6-yd. tractors. The former arrangement appears to be the more flexible of the two on account of the greater speed of the trucks.

The shovels in use are two 1½-yd. capacity, heavy duty type, one ¾-yd. shovel rigged with a special boom for the tunnel works in the draft tubes, one 1¼-yd. and one 1-yd. machines which can be used also as dragline excavators. The yardage of earth and rock to be handled is considerable—over 100,000 cu.yd. of rock and 64,000 cu.yd. of earth and mixed—and as the work progressed it was found that more trucks were needed than those bought when the excavating program was laid out. The additional trucks and tractors, usually 5-ton capacity, are hired locally as required. As many as 25 have been used at one time.

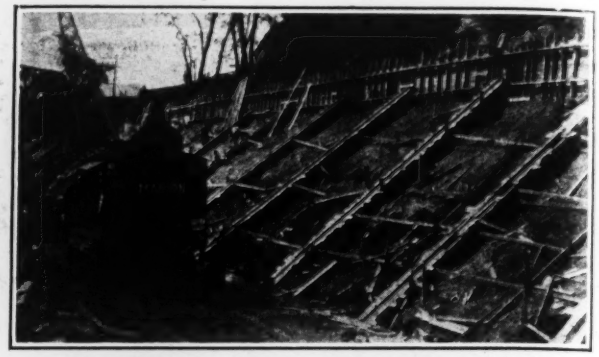


FIG. 5—FORMS FOR RIBS OF CANAL LINING

The rock equipment consists of two 1,250-ft. air compressors, 4 tripod drills for the tunnel work, 15 to 18 jackhammers, and one mechanical drill-sharpening outfit.

Winter Construction—Work on the western end of the dam was largely a winter operation, pushed to completion before the spring freshets. It was complicated by the broken and seamy nature of the rock bottom and by the nearness of the piers of the Boston & Maine railroad bridge; and as a result concreting did not get under way until the mid-winter months. The ¾-yd. mixer, batcher and bins were all housed in for protection against cold and steam pipes were put in the stone and sand bins. Live steam was fed into the water tank. At the sand pit, care was exercised in seeing that all sand was free from frost when loaded, the frozen surface skin being stripped off and discarded. In the rock-crushing plant, steam coils were put under the stock piles in order to keep the temperature of the stone above freezing. As a result of these precautions, the temperature of the concrete when it reached the forms was between 50 and 65 deg. Before any concrete was placed the forms and the rock bottom were thoroughly steamed to remove all frost. Two-inch lumber was used for outside forms to provide adequate insulation and the top of all concrete was cov-

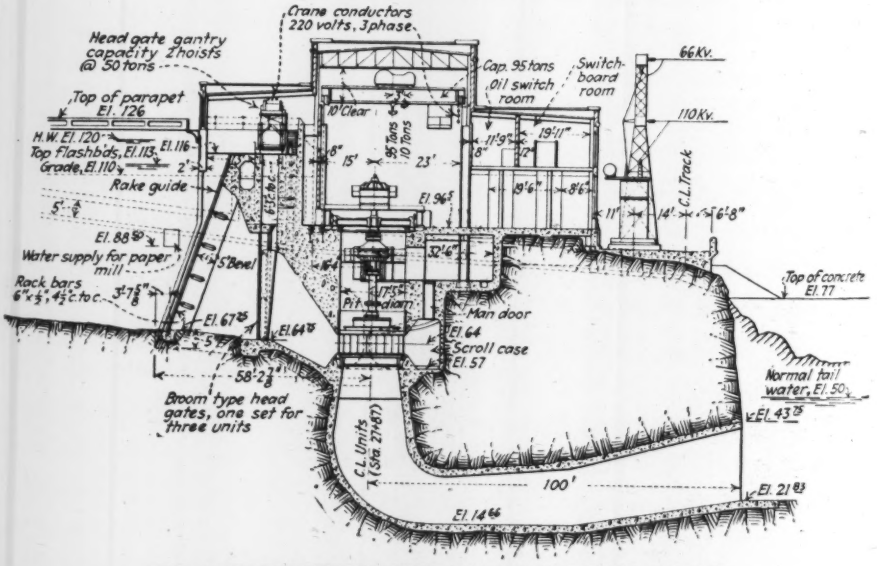


FIG. 6—CROSS-SECTION THROUGH THE POWER HOUSE

FIG. 7—POWER HOUSE FROM THE TAILRACE

The outlet end of two of the draft tubes can be seen at the upper end of the tailrace in the vertical rock face. The work of lining them with concrete was in progress when the picture was taken.

ered with tarpaulins with steam pipes laid under them during the periods of low temperature. The concreting plant was set up on the river bank and concrete was delivered to the job from tilting cars on a narrow-gage railway run out on the dam. Derricks were used to raise the concrete from the railway up into the piers between the spillway sections. A similar arrangement is being used in placing concrete in the eastern part of the dam, except that as it is not winter work no protection for the concrete or housing for the mixing plant is necessary.

Main Mixing Plant—One of the old mill buildings was used to advantage for the main concreting plant at the power house. The building stands on a steep hillside overlapping the site of the forebay and facing on Bridge St. with two floors below street level at the back of the building. The part of the building which was outside of the forebay area was left standing when the site was cleared and the mixing plant was placed on one of the floors below street level so that trucks with sand and stone could back in and dump directly into the hoppers above the mixer. Cement brought in in railroad cars was delivered directly to the ground floor from a spur run along the street to serve the old mill. The concrete tower was built against the high rear wall of the building at a point so close to the power house that practically all the concrete for the power house, head-works and retaining wall could be poured from chutes. Buggies were used to deliver concrete to the walls beyond reach of the chutes.

Concrete for the walls and ribs of the canal lining is being poured from a portable 2-bag mixer moved along the top of the bank.

Rock for the concrete is obtained from a crushing plant set up near the waste dump where good rock from the excavation can be delivered by the trucks en route to the waste dump. Sand is obtained from a pit within easy hauling distance to the job. No washing was required.

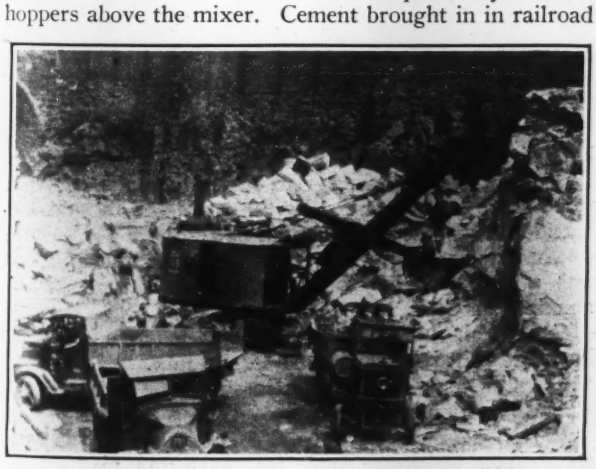


FIG. 8—HEAVY ROCK WORK IN FOREBAY

Rock is loaded into trucks to be hauled to the waste dump.

Construction was begun in the summer of 1926 and by adjusting the operations to suit weather conditions work has been carried on continuously throughout the Vermont winter with the loss of only a few days' time. It is expected that the power plant will be in operation about Feb. 1, 1928.

The turbines are being built by the S. Morgan Smith Co. and the generators by the General Electric Co. The annual output of the plant is expected to be about 135,000,000 kw.-hr.

This power plant is being built for the New England Power Association by the New England Power Construction Co. as engineers, and the Sherman Power Construction Co. as contractors. George S. Hewins is president of the Sherman Power Construction Co. and John V. Downing is superintendent of construction. R. F. Olds is resident engineer.

Flood Damage—Since this article was written the project has passed through the flood which occurred in the Connecticut and other rivers in New England early in November. The river rose 22 ft. in 24 hours, reaching a maximum stage of 125.7 on the afternoon of Nov. 4. Practically every operation on the job was drowned out but the damage was confined to loss of equipment and time. Water overtopped the cofferdam in the river shown in Fig. 2 carrying away part of it, also, it cut around the end of the dam on the New Hampshire shore washing out the approaches to both the highway and railroad bridges. The cofferdam at the upper end of the canal also was overtopped and water ran down the canal carrying debris down into the powerhouse and spilling over the uncompleted forebay wall at the right of the powerhouse. Below the falls, water backed up into the tailrace and switch yards and spread over the lowlands, flooding the crusher plant to a depth of 14 or 15 ft. Permanent structures suffered surprisingly little.

Tests Show Shrinkage Effect of Calcium Chloride in Concrete

CaCl Up to 6 Per Cent Increases the Shrinkage—Relative Shrinkage Over Plain Concrete Decreases With Setting Time

By A. S. Levens
College of Engineering and Architecture,
University of Minnesota, Minneapolis

FEW studies of the effect of calcium chloride upon shrinkage in concrete and mortars have been made, although some of its effects have been studied rather intensely within recent years. In general, the results of these investigations tend to show: (1) that calcium chloride, when used within certain limits (2 to 4 per cent based upon the weight of the cement), gives increased strength to concrete, particularly during the early periods; (2) that, beyond the critical percentage, further additions produce a reduction in strength as compared to similar concrete containing no calcium chloride; and (3) that concrete, with included amounts of calcium chloride and cured dry, is slightly stronger than concrete cured in water or in a moist room. (See *Engineering News-Record*, Aug. 5, 1926, p. 214.)

The accompanying results are from five series of tests conducted by the author at the experimental laboratory of the University of Minnesota, primarily to analyze the shrinkage behavior of concrete and mortars containing varying percentages of CaCl.

Mortar Tests—Seven pairs of 1:3 mortar beams (2 in. x 2 in. x 10 in.) were made for these tests. All beams were kept in a moist chamber one day, and then left in the laboratory (75 deg. F.) during the entire test period. The readings were taken with a Berry strain gage. Pair number one contained no CaCl, but in the next six pairs CaCl was incorporated in amounts, respectively, of 1, 2, 3, 4, 5 and 6 per cent. The test results are shown graphically in Fig. 1.

Mortar, Plain and with 2 Per Cent CaCl—In this series of tests, only the plain and the 2 per cent CaCl beams were studied. It was felt that, since 2 per cent CaCl gives added strength to the mortar when cured dry, additional shrinkage studies should be made of such beams. This series of tests showed that, at the end of 3 days, the shrinkage of the 2 per cent beams is about 100 per cent greater than the plain beams; at the end of 7 days, it is about 50 per cent greater; and at the end of 14 days and thereafter it appears to be constant, at about 85 per cent greater than the plain beams. The test period was 18 days.

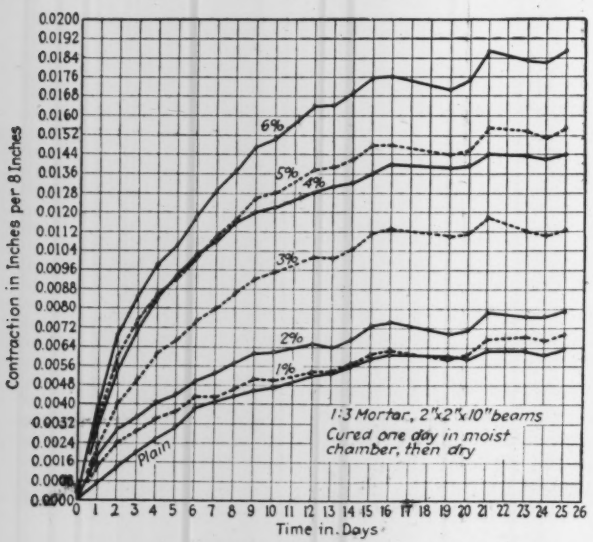


FIG. 1—SHRINKAGE EFFECT OF CaCl ON 1:3 MORTAR BEAMS

Beams of 1:2:4 Concrete—Seven pairs of 1:2:4 concrete beams (6 in. x 8 in. x 20 in.) were made, with a water-cement ratio of 0.936. The first pair contained no CaCl. The next six pairs contained 1, 2, 3, 4, 5 and 6 per cent CaCl, respectively. All beams were cured in the forms one day, and in laboratory air for the balance of the period. Although the original water-cement ratio was kept constant for all beams, the slump increased with an increase of calcium chloride. The results of these tests, given graphically in Fig. 2, show: (1) that the addition of calcium chloride in amounts greater than 1 per cent increased the shrinkage; and (2) that the greatest increase resulted from using 4 per cent CaCl which, at the end of 3 days, increased the shrinkage, over plain concrete, about 155 per cent, at the end of 7 days about 300 per cent, and at the end of 21 days about 150 per cent.

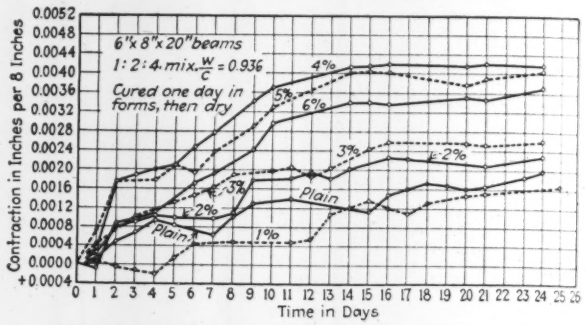


FIG. 2—SHRINKAGE EFFECT OF CaCl ON 1:2:4 CONCRETE BEAMS

Test Cylinders of 1:2:4 Concrete—Two pairs of 6-in. x12-in. cylinders using a 1:2:4 mix were made, the first pair being plain concrete, the second containing 2 per cent CaCl. To measure the shrinkage, four ⅜-in. steel plugs were set in each cylinder, in pairs 8 in. apart, and diametrically opposite. At the end of 3 days, the shrinkage of the 2 per cent cylinders was about 100 per cent greater than of the plain cylinders, at 7 days about 35 per cent greater, at 14 days about 60 per cent greater, and at 20 days about 45 per cent greater.

Slabs of 1:2:4 Concrete—Six slabs, 6 in. x 20 in. x 30 in., using a 1:2:4 mix were prepared, containing no CaCl, 2, 3, 4, 5 and 6 per cent respectively. They were cast on the ground, cured by the wetted earth, and left outside during the entire period of testing. No definite conclusions could be made from this test, although there was a tendency for the shrinkage to increase when amounts of CaCl up to 4 per cent were used.

Conclusion—(1) The shrinkage of concrete is greatly increased when CaCl is used in the mix.

(2) Considerable increases in shrinkage are apparent when the optimum percentage of CaCl is used.

(3) While the use of small quantities of CaCl, in concrete mixes which are made for pavements, may not be objectionable, in cases where shrinkage is an important factor, the use of the chemical is not advisable.

Studies of Axle Motion Caused by Road Surface Corrugation

ASSUMING that rhythmic corrugations in gravel roads are caused by erosion and air suction from automobile tires, studies were made by H. V. Carpenter and H. J. Dana, Engineering Experiment Station, State College of Washington, to determine the relation between automobile axle vibration and road surface corrugations.

An oscillographic recorder was mounted in an automobile body, with the drum revolving at a speed proportional to that of the vehicle. The relative motion of the rear axle with respect to the body of the car was traced by a pencil line on the drum. The resulting curve showed the natural period of vibration for the rear axle of a Ford car to be about 10.6 cycles per second when operating with standard tires under 55-lb. pressure, while a Buick car with cantilevered springs and 5.77-in. tires, carrying 34-lb. pressure, was found to have a natural period of vibration of 7.8 cycles per second. The records secured, however, were quite irregular due to the many disturbing elements, such as the effect of the front axle on the body and irregularities in the road surface.

In order to bring out the relations between the body, axle and road more clearly, a laboratory model axle was constructed, using weights one-fiftieth of the actual weight of a loaded body of a Ford touring car as supported by the rear axle. The "body" was connected to the "axle" by a spring 1/200th as strong as the Ford spring and the tires were replaced by another spring in the same proportions, connecting the "axle" with a reciprocating lever. This lever could be driven at various speeds by an electric motor and the amount of throw adjusted, as well. This motion produced the effect of rhythmic corrugation and duplicated the action of the rear axle of a Ford on a road, with all irregularities and disturbances eliminated.

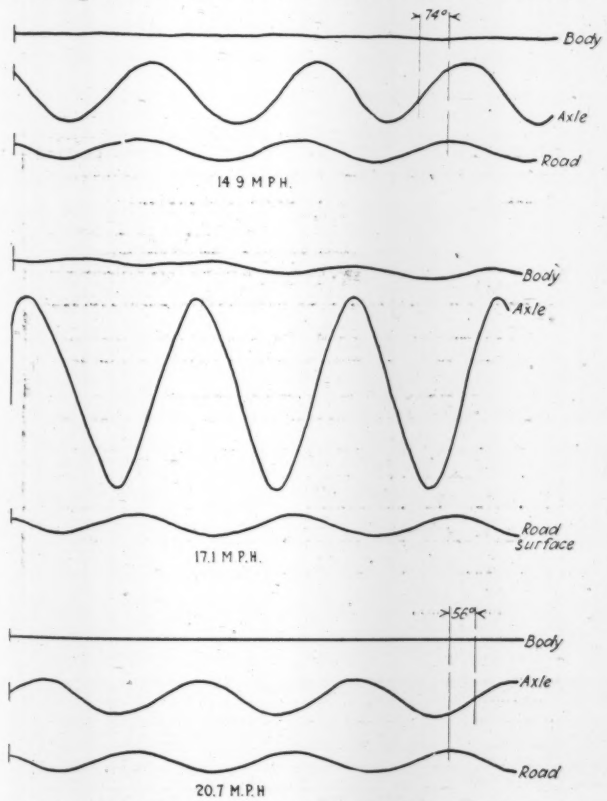


FIG. 1—OSCILLATION CURVES OF MODEL FORD REAR AXLE AT VARIOUS SPEEDS

Note axle vibration is about 8½ times the depth of road corrugations at speed of 17.1 m.p.h.

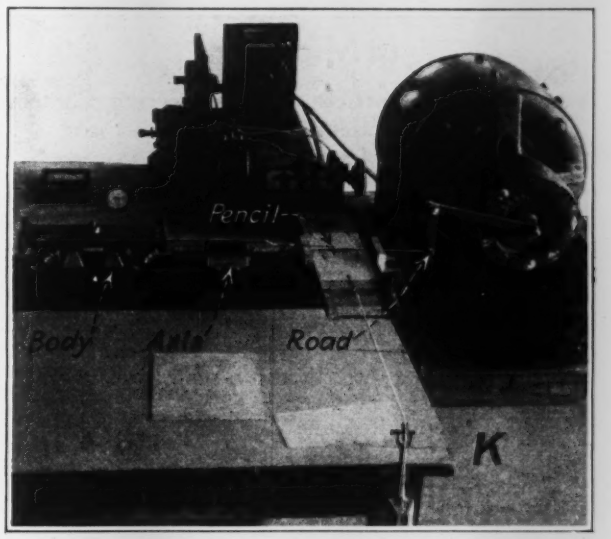


FIG. 2—MODEL TO SIMULATE AXLE VIBRATIONS

An analysis of the curves procured was attempted to determine the relations existing between the action of the axle by calculations based upon measurements of the deflection of the springs and tires.

One of the cars studied is typical of the light-car class, while the other is typical of the heavier cars which run at a higher average speed and are more likely to be equipped with shock absorbers. The results of the studies indicate "that the light cars, driven usually at about their resonant speed, are the guilty ones in cutting rhythmic corrugations" in road surfaces.

Further studies are proposed in order to determine more definitely the effect secured from both front and rear axles, the value of shock absorbers, the speed of cars, the effect of air pressure and tire size, the relation of axle weight and total car weight to the tendency to form corrugations.

A Snow-Control Road Bureau

To promote public opinion in favor of open roads in winter and also to serve as a clearing house of information as to methods of snow removal and disposal, the Bureau of Snow Control has been organized by manufacturers of equipment used in this kind of work. Another important purpose of this bureau is to collect information as to the amount of snowfall in different sections of the country, the special traffic problems during seasons of snow, and the design and selection of equipment suited to different conditions. In the collection of this information the bureau is receiving assistance from highway engineers and from agencies in the fields of highway transportation, motor equipment and road construction. No group of officers has been elected as yet, but it is planned to perfect the organization at a meeting to be held in connection with the Highway Convention and Road Show at Cleveland in January. The secretary is G. E. Wallis, 6 North Michigan Ave., Chicago.

Winter Construction of Road Bridges in Michigan

Standard Field Practices and Engineering Control Followed in Building Some 50 Structures During Last Four Winters

WINTER construction of road bridges is regularly undertaken by the Michigan highway department. In the last four winters it has constructed 47 bridges including both steel trusses with concrete floors and piers and all-concrete girder or arch structures. This winter the department expects to have at least 12 and possibly 15 or 16 jobs in progress. In general it does not hold that winter construction is as desirable as construction in warm weather, but it considers that it should be undertaken without hesitation whenever time gained in putting the road into service equals or exceeds in value the extra cost of doing work in winter. For concrete, this extra cost runs from $3 to $6 a cubic yard. Often, however, contractors bid as low in winter as in summer, the advantage of keeping their organizations intact and their equipment earning rental makes up for the extra cost of winter protection.

Specifications and Field Practice — The specifications for winter concrete are in all qualifications those for warm weather concrete plus requirements for heating, housing and curing. Concerning mixing the specifications state that:

> For any concrete which is mixed while the temperature of the air is lower than 40 deg. F., the aggregates or mixing water, or both shall be heated so that the temperature of the concrete, at the time of placing in the forms, shall not be less than 50 deg. F. and not more than 75 deg. F. In no case shall either mixing water or aggregates be heated to a temperature higher than 120 deg. F. Aggregates shall be heated by steam lines so arranged as to insure the uniform and thorough heating of the entire mass. Aggregates containing frost or frozen or hardened lumps shall not be used.

The limiting temperature of 120 deg. was adopted under the impression that greater heat would injure the cement. Later experience and all evidence have shown that no such injury results and now in the field considerably higher temperatures of water and aggregates are permitted. It is likely that new specifications will put a higher limit on temperatures.

Contractors' procedure and plant for heating materials naturally vary in detail but common bridge work exhibits enough similarity in structure type and volume of work to have developed common practices to a considerable extent.

The common method of heating aggregates is to pile them over perforated steam pipe grids. For heating water a steam jet in the tank on a coil in a large salamander are most common. Both require pumping and the latter involves the hazard of burning out the coils in case of pump stoppage. In case water can be drawn directly from the stream below good success has been had with steam ejectors, or siphons, which both pump

REPORT ON CASTING CONCRETE

Covering Casting of N. Abut. Girder Unit #11 Bridge File No. 740901

Date 1-29-1927 Time From 8-45 to 11-50

From 12-20 to 3-00

From to

Quantity of Conc. 34.5 Cu.Yds. Mix Used 1.0-2.7-4.3 Grade B

Cement - Estimated Amt. 43.12 bbl. Actual Amt. Used 42.5 bbl.

Consistency 2½ to 3"

Materials Proportioned by Cu. ft. box + templat wheelbarrows

Transported to Mixer by Wheelbarrows

Concrete from Mixer to Forms by Track cars and Chutes

Size and Type of Mixer 2-bag drum Lansing Reserve Mixer one bag tilter

Force Employed 1-14 + Contracts

Weather Cloudy Temperature Av 34°

Notes on Forms, Bracing, Tying

Sheeting 2½ T. & G. Studs 2×6 spaced 2' ± capped with a 2×6 s Waling double 2×6s Three walls with a max. spacing of 2½' Williams ½" rods maximum spacing 4' wooden spreaders between rods. Double 2×6s from top wale to bank max. spacing 7' 2×6s middle wale to bank max. spacing 10 ft. Short 2×6s bottom wale to bank max. spacing 5

Notes on Steel Spacing and Support

Steel spacing very good. Supported on chairs and 2×6's

Difficulties none

Shutdowns morning only

For Winter Concreting Give Temperatures Below

Time	9	10	11	11-50	12-30	1	1-30	2	2-30 3 Avg
Outside Air	32	33	34	34	34	34	34	34	34 34 33.7
Inside Housing	32	50	50	50	48	48	48	48	48 48 47
Mixing Water	110	110	112	112	114	112	110	111	114 110 111
Fine Aggregate	72	80	86	88	90	90	92	90	90 90 86.8
Coarse Aggregate	64	66	70	68	72	72	70	70	72 72 69.6
Conc. in Forms	64	70	70	70	72	72	70	69	69 70 69.6

Method of Heating Materials

Perforated steam piping

Method of Heating Housing

3 Stoves 2 Coke burning Salamanders Housing O.K. Temp. at 4 P.M. 60

Submitted Inspector Approved Project Eng. Noted Res. Eng.

CEF-165

FIG. 1—DAILY REPORT ON CONCRETE BRIDGE WORK IN WINTER

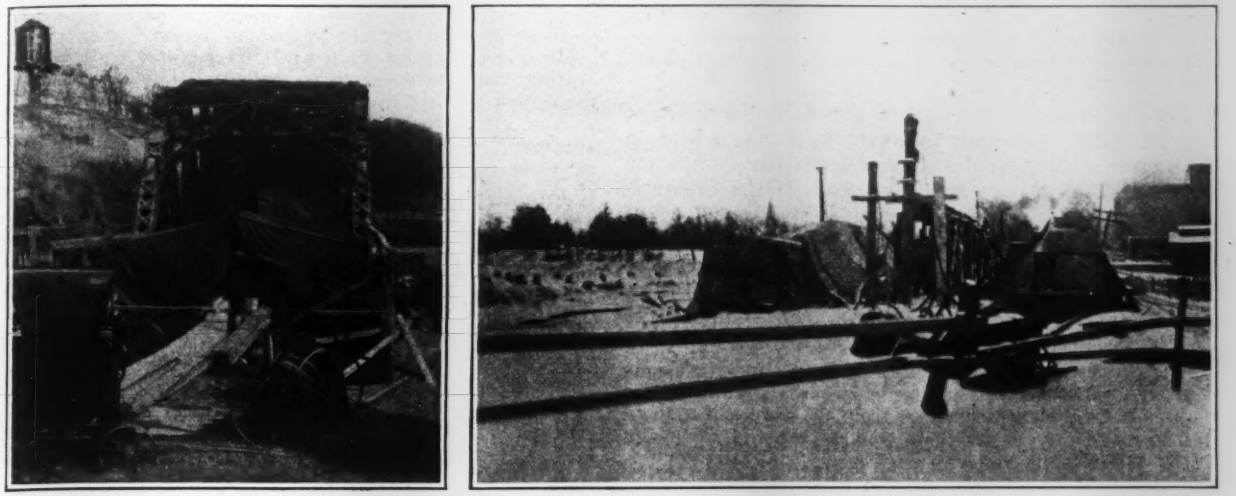


FIG. 2—TYPES OF CANVAS ENCLOSURE FOR WINTER BRIDGE WORK
Left: Housing for concrete floor for steel truss bridge. Right: Separate canvas covers for girders of concrete bridge.

and heat the water. The temperatures to which materials are heated are fairly indicated in the accompanying table, which records 16 separate runs, and also in the record, Fig. 1. Carriage to the mixers is usually by wheelbarrow. The mixers are commonly one- or two-bag machines and the batch is mixed 1½ minutes. Carriage to the forms is by wheelbarrows, hand cart or small tip cars on industrial truck. The distances are usually short. The table indicates temperatures at which the concrete goes into the forms.

For protecting the concrete in place the specifications require housing and heating. Housing requirements are:

All concrete which is cast while the air temperature is at or below 35 deg. F. shall be protected from freezing during casting and for a period of 14 days thereafter by means of a suitable housing of lumber, tar paper, canvas, burlap or other satisfactory material, and artificial heat shall be provided to maintain the temperature inside the housing at not less than 60 deg. F. during the casting and for the 3 days following the casting, at not less than 50 deg. F. during the next 4 days, and at not less than 40 deg. F. during the succeeding 7 days.

When the air temperature at time of casting is above 35 deg. F. but with a possibility of dropping below that point during a period of 14 days after casting, the contractor shall supply sufficient lumber, canvas, tar paper,

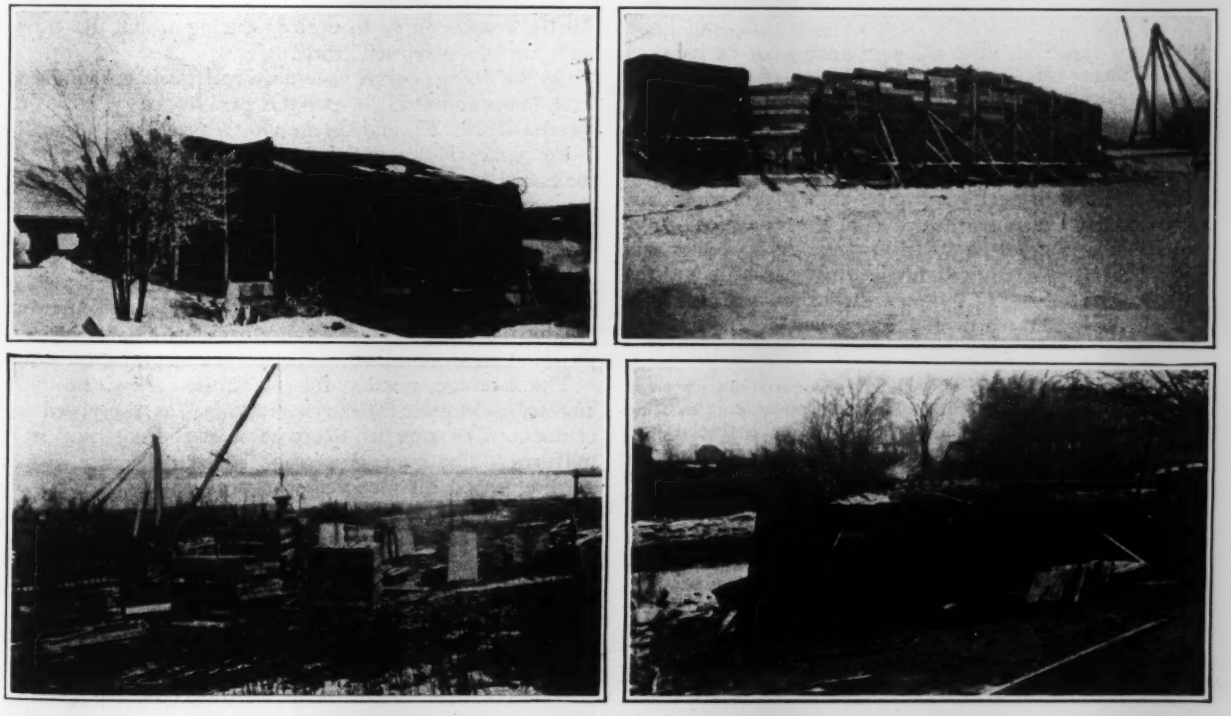


FIG. 3—TYPES OF HOUSING STRUCTURES EMPLOYED ON WINTER BRIDGE WORK
Upper left: Tar paper battened to timber frame. Upper right: Board-sheathed timber frame. Lower left: Portable board huts for footing pedestals. Lower right: Canvas spread over and battened to timber frame.

burlap, straw or other approved material and artificial heat, if necessary, to protect the concrete and keep the temperature of the concrete at all times during that period above 35 deg. F.

Several forms of housing are shown by the views of Figs. 2 and 3. Generally the covering is canvas held up by staging. Tar paper on timber frames or completely board-sheathed houses are also used. If the bridge is small the housing may cover the whole structure down to the ground. On larger operations only the portion being concreted is housed. The idea is to get a tight enclosure large enough to work in conveniently, without much regard to kind, and then keep it warm. The requirements for heating in addition to those first stated are:

Artificial heat shall be provided by steam lines, salamanders or stoves. Salamanders or stoves shall be used only if placed at a sufficient distance from the fresh concrete to insure against too rapid or uneven drying and shrinkage of the concrete; and the arrangement of such heating equipment shall, in all cases, be subject to the approval of the engineer, who may require the use of steam lines if he considers other equipment unsatisfactory.

RECORDS OF MATERIALS AND CONCRETE TEMPERATURES IN 16 DAYS' RUNS ON WINTER BRIDGE WORK

No.	Date	Vol. Cu. Yd.	Air Deg. F.	Water Deg. F.	Fine Deg. F.	Coarse Deg. F.	In Forms Deg. F.
1	Nov. 23	11.4	27	120	40	35	65
2	Nov. 30	11.4	33	120	65	50	57
3	Dec. 3	7.8	30	120	48	35	68
4	Dec. 10	7.8	31	110	105	80	80
5	Dec. 13	3.9	20	120	95	90	75
6	Dec. 21	3.9	38	120	75	70	75
7	Jan. 4	23	36	120	75	60	72
8	Jan. 5	21.4	24	120	68	40	68
9	Jan. 8	12.7	19	120	75	45	72
10	Jan. 12	12.7	30	120	75	50	65
11	Jan. 17	3.4	23	115	75	50	74
12	Jan. 21	3.4	27	115	75	42	74
13	Jan. 21	7.7	...	120	75	45	66
14	Jan. 24	7.7	...	120	75	45	67
15	Jan. 28	21.5	33	120	75	40	70
16	Jan. 31	22.2	18	110	55	45	65

In practice, steam lines are preferred for heating enclosures. With a perforated pipe, they give a moist air. Salamanders give a dry heat and in the small inclosures foul the air. On, say, a 40-ft. bridge a 20 hp. boiler will give all the steam required for heating materials and the housing. In putting in footings, steam jets are also used to keep the water warm and to prevent scale ice; very little steam is required. The specifications are:

In case a footing will be completely covered by water to a depth of not less than 6 in. immediately after it is cast, no provision need be made for enclosing it but artificial heat shall be supplied, if necessary, to keep the temperature of the surrounding water at not less than 35 deg. F. and this temperature shall be maintained for not less than 10 days after casting.

Whenever any portion of the concrete work is left during freezing weather with keyways, anchor bolt wells or other depressions on horizontal surfaces exposed, adequate provisions shall be made to prevent the accumulation and freezing of water in such depressions.

Curing is given particular attention in the specifications:

In case the structure or any portion thereof is enclosed and artificial heat provided for protection, the requirement of moisture for curing shall not be waived. The required damp sand covering shall be placed on floor slabs and wearing surfaces but the canvas or burlap covering for girders, etc., may be omitted. If steam lines are used for heating, the pipe connections shall be left loose to permit the escape into the housing of sufficient steam to maintain a moist atmosphere at all times. If stoves or salamanders are used, vessels containing water shall be kept on the stoves or salamanders for the same purpose.

Engineering Control—Control of work in winter, as at other times, is kept through inspectors and the engineers in charge. A daily report is made to headquarters using the form shown by Fig. 1. This is a report from an actual day's run, and it indicates the close check kept on all items. With this control, frosted concrete has been of rare occurrence and then only a shallow surface injury.

Curve Resistance of Freight Trains Determined by Tests

THAT curve resistance for freight trains on curves up to 3 deg. averages about ½ lb. per ton of train per degree of curve is the summarized conclusion based on recent tests. This addition to the limited definite knowledge available as to curve resistance, or train resistance as affected by curves, is afforded by the record of a series of tests made under the direction of the Engineering Experiment Station of the University of Illinois. These tests included 101 runs with five freight trains on curves of 1 deg. and 3 deg. From a report on these tests by Edward C. Schmidt, professor of railway engineering, as published in Bulletin 167 of the experiment station, the following conclusions are abstracted:

The tests were made on track of fair construction, laid with 70-lb. rails. The average gross weight of the cars varied from 15.1 to 48.6 tons. The weather was warm and only in two tests did the wind exceed 15 m.p.h. All but seven tests were run when wheels and rails were dry. All the results apply to periods during which the entire train ran upon curved track.

On the 1-deg. curve, the curve resistance amounted to 0.52, 0.46, and 0.55 lb. per ton per degree of curve, at speeds of 10, 20, and 30 m.p.h., respectively. On the 3-deg. curve it amounted to 0.64, 0.58, and 0.41 lb. at the respective speeds. Disregarding distinctions in speed, the general average curve resistance for all trains was 0.51 lb. per ton per degree on the 1-deg. curve, and 0.54 lb. on the 3-deg. curve. Since the superelevation on the 3-deg. curve was a little greater than is customary, it is probable that the results for this curve are somewhat greater than the curve resistance ordinarily to be encountered on this curvature. The excess is probably slight.

The average results for all trains show, on both curves, a decrease in curve resistance as the speed increases. The rate of decrease is not great, nor is it uniform. The general average curve resistance, disregarding speed distinctions, was practically the same on the two curves. The test results offer no clue as to whether the curve resistance would have varied with track curvature had it been practicable to test the trains on a greater variety of curves. The few tests run on wet rail afford some evidence that curve resistance is diminished when rails and wheels are wet.

The results may safely be applied to predict the curve resistance of all freight trains, running on either good or poor track, and under either summer or winter temperatures. It is not certain whether the results are applicable to curvatures much in excess of 3 deg.

Today in the Mississippi Flood Area

Engineering and Human Conditions in the Basins and Along the Levees as an Engineer Sees Them

By W. W. DeBerard
Associate Editor, Engineering News-Record

III—In the Mid-Section of the River

IN GENERAL plantations get larger and small holdings less numerous as one travels southward from Memphis through the Mississippi Valley lowlands. The picture of cultivation changes decidedly from that seen farther north, in the upper basin. How the land is utilized in the region lying between Cairo and the mouth of the White River was outlined in the first article of this series (see *Engineering News-Record* of Nov. 24, p. 828).

Intensity and method of land cultivation obviously have a bearing on land values, and these in turn will be a factor in determining what money should be spent on flood protection. Further investigation and inspection therefore were made in the region of Vicksburg, the mid-section of the flood basins. Opposite Vicksburg, near Tallulah, La., strenuous efforts are being made to break up some of the larger tracts to get white farmers on small tracts—40 to 160 acres—and by this means, together with diversification, make a start at solving some of the economic problems that have beset the South since ante-bellum days. With a view to learning trends as well as present-day conditions as affected by the flood of 1927, representative men were interviewed in Vicksburg and in the smaller cities and on plantations throughout the region.

Unusually Fertile Land

Work for 100 Days—Judge Harris Dickson, noted writer, whose articles and novels always involve some phase of the Southerner's problems, was full of interest about the situation. Illuminating views were obtained from him, with direct reflection on values as well as on the flood problem.

"First of all," said Judge Dickson, "we must tell the truth. The real trouble is that our lands are so rich and produce so easily that the laborer works only 100 days in the year." With this as a text anyone can sermonize as well as the Judge did to me. But coupled with the short season of activity there is also a lack of home-grown foodstuff.

"If I were a Czar I would abolish all can-openers," said the Judge. The importation of canned goods into this country is truly remarkable; it is perhaps one of the greatest factors in causing pellagra, a disease on the increase since the flood. Dairy products *imported* into Louisiana are said to more than equal the value of the rice, sugar and tobacco crops produced in the entire region.

Land that can support a family on 15 to 20 acres with 100 days' work, as happens on many a plantation, does seem worth protecting, even without further inquiry into unit costs, if only there are enough acres. An economic survey as to the amount of such land in cultivation and the future possibilities of reclaiming further acreage is an apparent necessity. Typical of the kind of information that needs careful analysis is a table furnished through the courtesy of the Illinois Central R.R. officials at Vicksburg:

COTTON YIELDS IN THREE LOUISIANA PARISHES

Parish	Total Area Acres	Acres Flooded	1926 Cotton Acreage	1926 Yield Bales	1927 Cotton Acreage	1927 Yield Bales
Madison, La.	369,300	275,000	38,000	15,449	12,500	1,000
Richland, La.	339,900	245,925	79,904	33,034	41,000	15,000
Ouachita, La.	401,300	150,000	45,600	17,123	36,000	10,400

As a bale of cotton this year is worth more than $100, the difference between the cotton yield of 1927 and that if 1926 is easily figured.

What Real Estate Men Think—Three real estate dealers in Vicksburg were interviewed together through the courtesy of M. L. Worrell, water-works superintendent. Mr. Worrell had just taken me to see his plant, which he kept in operation during the flood, although the water was within a few inches of the top of the filter and clear-water basin walls, as well as up against the pumping station windows and doors. Higher floods are not wanted in Vicksburg, though that city is mainly on a high bluff; the city depends too much on its "back country." The real estate men were, respectively, a Southerner, a man from Michigan and one from Indiana.

Land Value—Various figures of peak value of farming land before the flood were given, up to $400 per acre, but the average was finally placed at $150. The same kind of land today has a value of $50, but buyers are scarce. The flood has put a lot of land on the market, yet the flood is not the whole reason for reduced values. For example, poor management and a loss on last year's crop because of low prices are reasons in addition to the killing of a young pecan grove by the flood for a forced sale of an 8,000-acre plantation (3,100 acres cultivated) at $10 per acre, if a buyer can be found. This acreage is composed of three old plantations, one of which is said to have made millionaires of men now living in Vicksburg. The flood backed water over this property about 17 ft. deep. That levees have been the ruination of this acreage and thousands more in the same locality is generally admitted by all who are familiar with the engineering facts. The owners would gladly sell their holdings at reasonable figures for reservoir purposes. The location is the Yazoo delta.

Loans and Foreclosures—During the peak of prices for land, 5 to 6 years ago, the Federal Land Bank loaned up to $50 per acre on some of the then $150 land. Much of this land can now be bought for $50, and the buyer need advance only enough cash to put the loan back in good standing, plus the cost of transfer and back taxes (from $3 to $15). There are a number of transfers in this category. The banks and mortgage people are only too glad not to be forced into operating the plantations.

The three real estate men supplied checks on Judge Dickson's views, besides expressing themselves on other questions. Thus: Cotton is raised in preference to

other crops because it is so easy to handle; the ground just needs to be scratched, the Michigan man said. The laborer likes it because it is a "waiting crop"—it can be planted safely within a range of at least two months and picked all fall, up to plowing time in January. The yield is nowhere near what it might be with more plowing and fertilizer. An agricultural experiment station has grown three bales to the acre by numerous plowings plus 180 lb. of fertilizer.

Diversification was the hobby of both men from the North. Soy beans, which produce about 30 bu. to the acre, and cattle raising (stock can be pastured the year around) were noted specially.

Of acreage not in cultivation, cutover lands predominate in Louisiana, just across the river from Vicksburg. Only a few large original timber holdings remain, notably a 60,000-acre tract belonging to a Northern manufacturing concern. Clearing of the cutover land averages $10 per acre, the real estate men stated—this figure should be compared with the higher figures given in the first article of this series. It is usual, however, to give the crop to the laborer for three or four years for the clearing he does; what the cost is can not be estimated in this case.

Bankers Express Their Opinions

From the Banker's Viewpoint—Two bankers, in Vicksburg and in Tallulah, were quite optimistic on the financial situation. Both agreed that the greatest strain on credit was to come near the first of the year, when arrangements must be made for the 1928 crop. The planter must feed his labor for two months before there is work to be done, and then on until the crop is harvested. The Red Cross ceased its activities late in the year, in most cases throwing the responsibility back on the planter. Credit is not going to be so good, but the banks will take the burden and with a good 1928 crop the bills will be paid and loans materially reduced.

Of course, loans will not be made so freely as heretofore. The man who "must have" $5,000 will have to do with $2,500. Interest to old mortgage holders will have to wait and not be paid out of new loans, said W. S. Craig, president of a Tallulah bank. Not even the Federal Land Bank, he felt, should expect interest out of new loans. However, the Land Bank has ruled that each case will be taken up separately; it can hardly do otherwise than keep its investments on a thoroughly solvent basis and maintain their status as first and preferred liens.

Tallulah is in Madison Parish, in the heart of the Tensas Basin, and was practically all under water. In this parish only 8 per cent of the usual cotton crop was produced, but twenty times as many cow peas were grown, declared the banker, and he produced his financial statements of now and of six months ago, showing no impairment of strength. Like statements apply to surrounding parishes, he claimed. I conclude that in this district, at least, the banks are in good condition and will be able to meet the strain which they are called on to meet.

Not all banking situations are equally rosy, however. The Arkansas City bank failed, carrying away with it $76,000 of the local levee board's funds. It is fair to add that this particular bank is said to have been close to the edge with frozen assets for several years, and the flood finished it.

A Tallulah Lawyer—From H. G. Sevier, a lawyer at Tallulah, another angle of the case was obtained. Two-thirds of the expense for the 1927 crop had been incurred when the flood came. Mortgage paper covered much of this expense. Most of the planters make their crop on a borrowed-money basis, so that it hit them hard. Large acreages are covered with mortgages of $15 to $25 per acre—on $50 land!

In Mr. Sevier's opinion the big plantation system is running out. Labor is too undependable. The tenant system with share-crop basis of compensation will not last, in his opinion. The laborer moves on too easily, leaving his debts behind him. Few laborers will assume the responsibility of debts incurred before the flood; this leaves the planter holding the bag. The flood stampeded labor only for the time being; much of it has returned.

At this point Mr. Fenn, former agent for the Sondheimer Timber Co., owner of 20,000 acres of cutover lands, came in with some pertinent additional facts. His company will build a prospective buyer a $1,500 four-room house, drive a well, and turn over 40 to 160 acres of land, for *nothing down*. There is a signed "contract to buy" at $50 per acre at the end of four years, all profit from crops raised going to the buyer. A real worker can pay out in about five years, in Mr. Fenn's opinion. Twenty-five acres can be cleared and a crop put in the first season. This, with outside work available, will enable a man with little capital to succeed. The floods will not come again, Mr. Fenn feels, but if they do his farmers have demonstrated that they can "go behind" the flood and still grow a crop that will support them.

Taxes, Mr. Sevier resumed, are assessed at full value, $40 for first-class land and $20 for open land. The rate is 28 mills, of which 3 to 5 mills are for levees. In addition, every bale of cotton is assessed $1 for levee work. The great trouble with the country, he said, is that owners have too much land; so much they cannot get it all cultivated. Only an exceptionally good manager will succeed, as in any other business running to upwards of $100,000.

Views of a Large Landholder

Experience of a Contractor-Senator—Some 37 miles north of Tallulah, near Lake Providence, is the plantation of Senator Norris Williamson. It faces directly on the levee. As most of the Senator's land was under water last spring, and he also has been a levee contractor during 30 years, his views were sought with a great deal of interest.

To begin with, the Senator checked up the uncertainty of labor, but he has studied the reason therefor. It is largely due, in his opinion, to the fact that the tenant has nothing to hold him. He knows he cannot own, hence he takes no pride in fixing up a rented place, nor in planting trees or shrubs to increase the attractiveness of its surroundings. Yet the share-crop system has become so much the custom that it is not likely to be changed, certainly not for cotton. Feed crops generally are wages crops—labor receiving $1.25 to $1.50 per day plus tenant house and the usual perquisites of truck patch and wood from the timber land. Practically every plantation has one-half to one-third uncleared cutover land for pasture and wood, or swamp area.

As to diversification: Labor does not like to raise anything but cotton. It is a cash crop, while all feed crops which the planter raises, such as corn, hay, peas and beans, are wages crops. These conditions are reflected in the land prices, which, before the flood paralyzed sales,

were $75 to $100 per acre (for good land; cutover lands are not salable, for there is more cleared land now than can be cared for). On the other hand the cost of growing cotton is continually increasing, the Senator said. It now costs about 15c. per pound on the average, and unless there is more than 7 to 8c. profit money will not stay in the business.

This last statement brought us to co-operative marketing rather naturally, for the Senator has long been an officer of the State Cotton Growers Association, organized to sell the cotton of its members co-operatively. Some of the difficulties of such co-operation came to the fore: The association has a hard time holding its members. Those who finance the planter are usually interested in buying cotton or in handling it in some way, and are cut off from a profit when the member pools his cotton; naturally, it does not take much to discourage the planter from sticking to the association when his banker shakes his head. Mr. Williamson is not pessimistic, however, over the marketing situation. The schools are carrying co-operative marketing courses, and the general education of the next generation, he feels, will show definite results.

So long as 60 per cent of the cotton is exported, and weather variations affect the yield by 20 to 25 per cent, a surplus is sure to be raised every so often. Cotton does not deteriorate in storage, therefore the surplus may easily be made a reservoir to even up peak demands in lean years of production. It remains to find finances to carry the load. Legislation may help, but education must accompany it to make the planter see the advantage of co-operative selling. All of this has point, for unless the cotton raiser can make money the lands will depreciate to the point where their protection becomes of doubtful advisability.

TYPICAL FARMER TENANT'S HOUSE AFTER THE FLOOD

How to Improve the River—The Senator has decided views on a few of the problems of the river system. First, he would straighten out a number of bends that hold back the water. In the beginning the levees grew in an extremely haphazard manner, being built low by plantation owners close to the river. These wrong alignments have persisted in only too many cases, for the sake of saving individual holdings. Construction of the available cross-section of flood way at several points does not permit the water to discharge as fast as it should. Ashbrooke Neck and Leland Dikes were noted as having water 5 and 6 ft. higher on the upstream side during the last flood. At Vicksburg the width between hills and west levee is a mile and upstream it is 8 to 10 miles. Set-backs at these points and removal of the obstructing dikes are extremely desirable, in his opinion.

Again, having had experience with many miles of levee topping and its effect on the M.R.C. section, Senator Williamson feels that the back face of the levee should be so shaped that it will not permit the line of saturation to come to the surface when the river stage rises to the top, as the present section does.

Another Plantation Owner—George S. Yerger, owner of a plantation at Mound, La., having in excess of 15,000 acres—practically all inundated—had his land covered so long a cotton crop was impossible this year. But in general Mr. Yerger feels that he has two main difficulties, neither of which is the Mississippi: (1) he has too much land, and (2) his help is too uncertain. The one problem is the corollary of the other. The debts of his tenants, incurred at plantation stores previous to the flood against their prospective share of the 1927 crop, were cancelled by Mr. Yerger. Yet many of the tenants come in and want to move on in spite of the fact that they will be advanced living expenses just as they have in the past—perhaps not as bounteously as in other years, but still enough to cover necessities. While there will be no loans with which to buy the laborer an automobile, nevertheless plenty have found the means to possess one (at a rough estimate, after driving more than 1,000 miles over the flood areas, I would say that at least 50 per cent of the cars encountered were driven by farm laborers).

Smaller places more intensively farmed, Mr. Yerger feels, should be the order. In consequence his agents are North seeking buyers of land. Their search is proving successful, but unfortunately the buyers are taking large, not small, blocks of land. The plague of absentee landlordism may be the next stage, therefore.

Machinery would help farm these lands which are calling for labor, but that requires more skilled labor than is available. Mr. Yerger is directing executive of a cottonseed oil mill, a lumber company and a bus line, and is director of the Tallulah bank noted earlier. Recently at a meeting of the thirteen directors, he stated, every loan was gone over, and but a single small one was considered doubtful. The bank has reduced its usual 12 per cent dividend to 8 per cent as a matter of conservatism, thereby increasing materially the surplus and profits figure.

Coming Changes in the System—One direct result of the flood has been the more thorough conversion of men like Mr. Yerger to the idea of smaller holdings intensively cropped, and more diversification. "We have been too busy with the main or cotton crop to pay attention to any other," he said.

As the cattle ranges of the West gave way before the fence-farmer, so labor troubles and the flood may accelerate the trend toward smaller ownerships. Movement of the existing plantation labor to the cities of the North may thus be offset in no small measure.

All the men interviewed—and there were many more than are here indicated—felt that protection from another flood will be given, but that regardless of what would be done the land is so rich that a good crop and a good price will put everybody even with the board. None felt, however, that any further local contributions for river control could be made, or should be asked for. It is now the nation's business, they hold.

Brass Wire Models Used to Solve Indeterminate Structures

Calibrated Stock of Wire Facilitates Easy and Cheap Preparation of Models—Deflections Measured With Ordinary Scale

By Anders Bull
Board of Transportation, New York City

IN APPLYING the mechanical method of stress analysis devised by Prof. George E. Beggs of Princeton University to practical problems, the author has obtained some very satisfactory results by substituting brass wire models for those made of cardboard or celluloid sheet, as ordinarily used with this method. The substitution renders the cost of the necessary equipment insignificant, so that the advantages of the Beggs method may be enjoyed by any designer reasonably skilled with his hands. In giving the following outline, it is assumed that the reader is familiar with the working principles of this method.

In working with brass wire, large deflections are used so that the flexure lines may be drawn direct on paper by running a ruling pen along the deflected model. From these lines, using an ordinary scale and the unaided eye, one may determine the stresses with surprising accuracy.

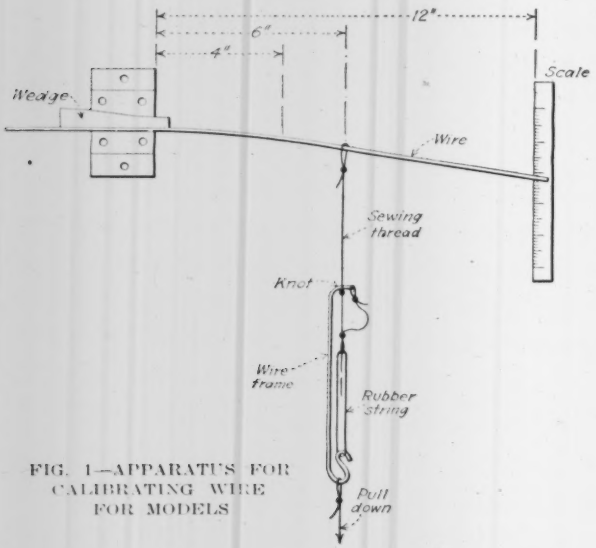


FIG. 1—APPARATUS FOR CALIBRATING WIRE FOR MODELS

No undue claims as to originality are made for the proposed substitution, Prof. Beggs having used wooden splines and large deflections in his first experiments, while Otto Gottschalk in his "Continostat" has recourse to tempered steel splines placed on top of cross-section paper on which are measured the deflections.

Brass wire, however, possesses certain advantages over splines of wood or steel, apart from the low cost of the equipment: (1) It can be soldered, thus facilitating the joining of pieces in building up either two- or three-dimensional models; (2) the cross-section and elastic properties of a drawn wire are uniform throughout its length; although the elasticity may differ considerably in different sizes, and even in different lengths of the same size, these variations may be ascertained by test, and compensated for; (3) under the trade name "brass drill rod," the wire is obtainable in straight lengths of 3 ft., and in a great variety of sizes, thus affording a wide selection for making the equivalent moments of inertia of model and structure proportional at corresponding points; (4) being what is termed "semi-hard," the wire will usually stand large deflections without permanent set, but is easily cut and bent to any desired angle; and (5) wire, like cardboard, makes flat models which are readily stored for later reference.

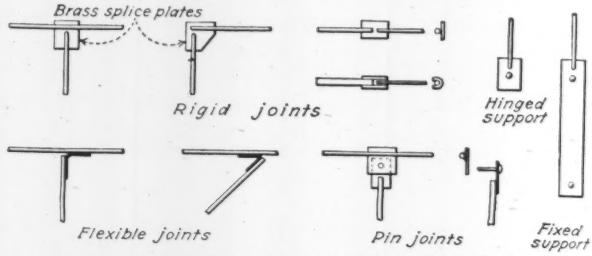


FIG. 2—TYPES OF JOINTS USED IN WIRE MODELS

A stock of about 20 different sizes of the rod should be kept on hand so as to have a certain freedom of choice when a problem comes up; numbers 35 to 55 twist-drill gage are suggested.

Calibrating the Wire—In Fig. 1 is shown a simple, homemade appliance for testing the wire. Held by the insertion of the wedge, the wire is bent by a gaged force applied 6 in. from the support. The inverse value of the deflection, as measured by the scale, 12 in. from the support, is then proportional to the product of moment of inertia times modulus of elasticity, and represents the "equivalent" moment of inertia referred to above. It is conveniently determined for all the wire in stock, the wire being tagged correspondingly.

The deflecting force is gaged by a dynamometer (shown in Fig. 1), comprising a rubber string tied to a piece of sewing thread and held in a wire frame. The thread is slung around the wire to be tested, and the rubber string stretched, the desired force being indicated by the position of the knot below the top of the wire frame.

Making a Model—In assembling a model, the wires to be used for its different members are selected from the table of inverse deflections, a set of values being chosen which are, as nearly as possible, proportional to the moments of inertia of the corresponding members of the structure. The wires are cut to proper sizes and the pieces arranged on top of a diagram of the structure.

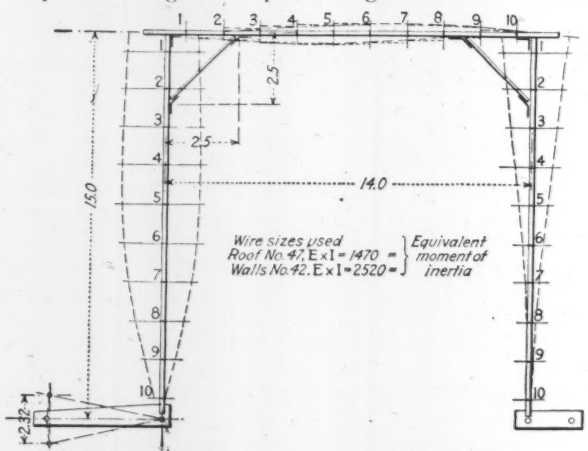


FIG. 3—A SUBWAY FRAME MODEL

Splice plates are cut from 26-gage semi-hard hoop brass $\frac{3}{8}$ in. wide. Strips of gummed paper, through which the wires have been stuck, serve to hold them in place while the joints are being soldered. A good contact during soldering is secured by placing paper weights on the wires near the joint.

Joints are made differently, as shown in Fig. 2, according to whether they are considered rigid, flexible or pin joints. Flexible joints are made from flat strips $\frac{1}{8}$ in. wide, bent to an angle and placed on edge. Pin joints are made from two plates having holes in them, a brass wire nail which fits the hole snugly being put through and soldered to the bottom plate. Hinged supports are made of a plate with one hole in it through which a nail is driven into the board; fixed supports have holes for two nails.

The finished model is next adjusted on top of the diagram, the supports being secured by nails. Bent to either side and released, the model should swing back to the original position. If it does not, the friction is too large, and should be reduced by placing a brass ball between the model and paper at one or more of the splice plates.

Using the Model—The support to be investigated is then displaced by equal amounts in opposite directions, and the respective flexure lines drawn. Since, for determining the three unknown quantities for a fixed support, three sets of flexure lines are required, inks of different color should be used to avoid confusion.

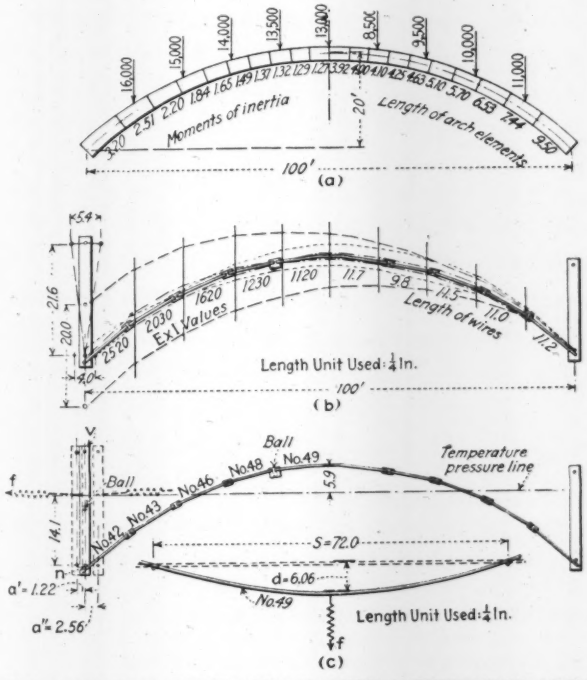


FIG. 4—USING A MODEL TO ANALYZE A FIXED-END ARCH
(a) Arch elements and loads.
(b) The model with the various flexure lines.
(c) Determining crown moment due to temperature.

Points whose deflection is desired are marked on the model with ink, and after displacing the support their new position is indicated by dots on the corresponding flexure line. Projecting the two dots yielded by opposite displacements upon the direction line of the force acting at the corresponding point gives the deflection F which is considered in determining the influence factor G. Multiplying the force by G gives its share of the reaction at the support.

For any lateral displacement, D, we have: $G = F/2D$, while for an angular displacement V: $G = 2F \times \text{cotan } V$. As to sign, it may be noted that a reaction is positive in the direction of the displacement if the latter causes the point considered to move in a direction opposite to that of the force.

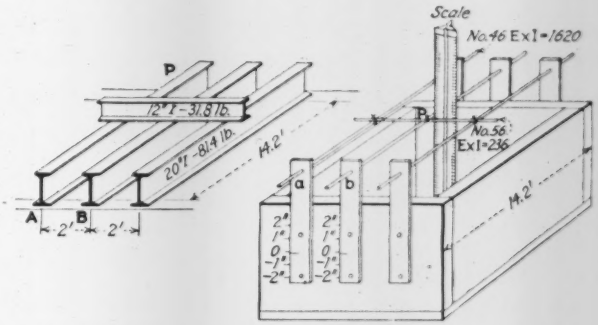


FIG. 5—MODEL FOR ANALYZING A GRILLAGE

Analysis of a Subway Frame—The model shown in Fig. 3 represents a subway frame with knee-braces and fixed column footings, sustaining a roof load of 7.5 k. per ft. and a side pressure increasing from 1 k. per ft. at the top to 2.51 k. per ft. at the bottom. The value of k., a kip, is 1,000 lb. Dimensions are given in inches, the scale of the model being 1 in. to 1 ft. The roof member is a 10-in. 25.4-lb. I-beam, and the side members are 12-in. 31.8-lb. I-beams. The moment at the left footing was found from a displacement as indicated to be: due to roof load, —59.54 ft.-k.; due to side pressure, +59.87 ft.-k. The computed values are, respectively, —59.22 ft.-k. and +60.17 ft.-k.

Analyzing a Fixed-End Arch—Fig. 4a shows the fixed-end arch illustrated in Turneaure & Maurer, "Reinforced Concrete Construction," 1919, p. 360. The model Fig. 4b was made to a scale of 1 in. to 4 ft. from wire of five different sizes. The following reactions were obtained for the left abutment: horizontal, 76.42 k.; vertical, 61.72 k.; moment, 38.2 ft.-k. The computed values are, respectively, 76.76 k., 61.72 k. and 20.7 ft.-k., the discrepancy in the latter figure representing a shifting of the pressure line by 2.1 in. in a section 42 in. deep.

To find the temperature stresses, the dynamometer shown in Fig. 1 was applied to the left support after removing both nails, Fig. 4c. The temperature pressure line was first located by finding the position at which the force f must be applied in order to move the support horizontally without rotation. It proved to be 5.9 units from the crown, as compared to the computed value 5.11.

The displacements to right and left produced by the same force f were 2.56 and 1.22 units, respectively, or an average of 1.89. This was compared with the deflection produced when the force f was applied, as indicated, to a wire of the same kind as that used for the crown, and spanning 72 units. The same relation must obtain between the displacement of the arch abutment due to the temperature force, and the deflection which that force would produce if similarly applied to a concrete beam of the same section as the crown and spanning 72 ft. Having thus determined the deflection, the force is found by the standard formula to be 2.70 k., giving a

moment at the crown of 15.92 ft.-k. The computed values are 2.97 k. and 15.20 ft.-k.

Analyzing a Grillage—Fig. 5 shows a three-dimensional problem of a type frequently encountered in subway work when resting grillages on the roof beams. The model was made to a scale of 1 in. to 1 ft., one No. 56 wire being tied to three No. 46 wires, in the manner shown. By displacing supports *a* and *b* plus and minus 1 in. and observing deflection at *P* on the scale, the reactions at *A* and *B* were found to be 0.154*P* and 0.194*P*, as compared to the computed values of 0.151*P* and 0.198*P*. Displacements of plus and minus 2 in. gave the values 0.152*P* and 0.184*P*.

Activation in Sewage Mass Effected By Diffused Air

EVIDENCE supporting the value of air diffusion in the activated-sludge process is presented by Gilbert J. Fowler and S. N. Chatterjee in *The Surveyor* (London) for Aug. 12, 1927. Dr. Fowler, many will remember, was formerly chemist of the sewage-works of Manchester, England, and, after a visit to the experiment station at Lawrence, Mass., set in motion the development of the activated-sludge process in England. Since going to India, Dr. Fowler has continued his activities in sewage research and its practical application. The paper mentioned describes laboratory experiments promoted by the too ready acceptance at face value of general assertions that diffused air serves chiefly as a mechanical agitator, with a minimum absorption in the body of the sewage, and that most of the aeration takes place at the surface. After introductory remarks and citations to the effect that surface aeration may do effective work, particularly in shallow tanks, the authors continue:

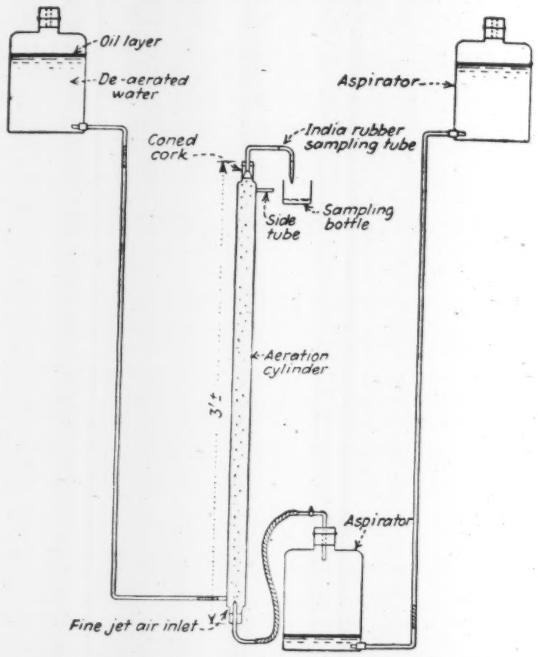
> While, therefore, the importance of upper surface aeration is conceded, it by no means follows that the aeration taking place at the surface of innumerable bubbles is negligible. Ordinary experience in the solution of gases in liquids is opposed to such an idea, and in the pioneer experiments by Ardern and Lockett (*Jour. Soc. Chem. Ind.*, Vol. XXXIII, p. 1123) it was shown by quantitative measurements that the efficiency of aeration was greatly increased when diffusers, rather than ordinary pipe nozzles, were employed for introducing the air.

The possible criticism remains that even so the bulk of the aeration comes by "streaming" from the upper surface when the bubbles break. To meet this criticism the authors devised an apparatus (see sketch) in which bubbles of air were passed through a column of water under such conditions that no streaming from the surface was possible. Air-free water was passed at a slow rate through the aerating cylinder out through the cork and into a sampling bottle, and the dissolved oxygen determined; the amount present was found to be quite small.

The de-aerated water was then allowed to remain in the aeration cylinder for 24 or 48 hours to see what amount of aeration, if any, took place through streaming effect when the apparatus, including the exit tube, was quite full, and when it was full to an inch or so below the cork, thus leaving a surface exposed equal in area to the section of the cylinder, finally air was admitted in slowly moving bubbles about the size of lentils, the water also being kept slowly moving. No accumulation of air took place below the cork, and no bubble could break till it reached the outlet of the narrow exit tube.

After allowing air to pass for the required time it was shut off, the water still continuing to move through the apparatus. As soon as the last bubble of air had passed out a sample of water was taken, and its dissolved oxygen content determined.

The results are given in the following table, the figures being the actual amount of oxygen present in the sam-



APPARATUS FOR STUDYING SEWAGE AERATION

The aeration cylinder was the outer jacket of a Liebig's condenser. The water in the top left hand bottle was approximately freed from air by bubbling carbon dioxide through it; the oil layer excludes the addition of air. The cork at the top of the aeration cylinder is coned out to avoid entrapping air.

pling bottle, which had a capacity of rather more than 200 cc.:

Dissolved Oxygen in Milligrams

No. of Expt.	A	B	C	D
1	0.3	0.21	1.0	1.60 (½ hour)
2	0.45	0.45	0.96	1.56 (10 mins.)
3	0.30	0.32		1.20 (10 mins.)
4	0.2	0.24		1.00 (10 mins.)
5	0.2	0.24		1.10

A = original water; B = water left 24 hr. in full apparatus; C = water left 48 hr. in partly filled apparatus; D = water after aeration for given period.

It is evident from these figures that a great deal of aeration takes place from the surface of the air bubbles as they ascend the column of water, even when their number and speed is much less than is customary in large-scale operations. As a further proof that aeration takes place from the surface of the bubbles, solutions of manganous sulphate and caustic soda were introduced by the side tube. A white precipitate of manganous hydroxide rapidly became brown as it passed down the cylinder.

The results recorded in this paper show clearly the truth of the contention expressed by C. H. Hurd, sewage engineer to Indianapolis, in *Engineering News-Record*, Aug. 16, 1923, p. 248:

> The advantage of air circulation over such mechanical agitation as we have knowledge of is that with equal opportunity for economy due to the surface absorption of oxygen, there is an assurance of always having a sufficient quantity of entrained air to give positive oxidation throughout the sewage mass.

Preserving Road Investment by Asphalt Surfacing

Growing Field for Bituminous Secondary Type Roads and for Utilizing Old Surfacing as Bases for Asphaltic Surfacing, Discussed by an Asphalt Road Conference

THE use of asphalt for intermediate type roads has been one of the most notable developments of the last three years in public roads construction. Briefly it has been found by one trial after another that old road surfaces of gravel, fine stone and even sand can be mixed on the road with asphaltic oil and made to give excellent light traffic highways. It has been found that old gravel and stone roads can be surfaced with premixed asphaltic concrete and produce highways which are inferior in traffic capacity only to the rigid type pavements. It has been found that rigid pavements nearing the end of their service life can be preserved and made a component part of a new pavement, by asphalt surfacing. These are important economic advances in road building, and lend interest and value to the four papers which are given in abstract here.

* * *

The Dimensions of America's Public Roads Undertaking

By Thomas H. MacDonald
Chief, Bureau of Public Roads, Washington, D. C.

AT THE end of this year, we estimate, there will be in service about 23,300,000 motor vehicles, an increase of about 6 per cent over last year. There will have been consumed during the year 10,720,000,000 gal. of gasoline, an increase of 9 per cent over last year. If there was an average operation of 12 miles per gallon, the combined rural highway and city street costs for the year were about 1 cent per vehicle-mile. At a retail price of 20c per gallon, the value of the fuel consumed is $2,144,000,000. The use of gasoline by the individual motor car is estimated now at 460 gal. for the year, an increase of 3.6 per cent over last year. It appears, therefore, that in addition to a 6 per cent increase in the number of vehicles in use, the use of the vehicles themselves is increasing. The indicated total utilization of our rural highways and our city streets approximates for this year 128 billion vehicle-miles.

The present statistics are as follows:

Total mileage of public roads	3,006,081
Per cent of total mileage surfaced	17.4
Mileage of state highways	274,910
Mileage of state highways surfaced	144,854
Per cent of state highways surfaced	52.5

The federal highway system consists of 185,772 miles running coincidentally with the state highway system. Highways, to be suitable for continuous use of motor vehicles, must be surfaced. Today 47.2 per cent of the state highways have yet to receive initial surfacing, 82.3 per cent are still unsurfaced or surfaced with types that must be considered transitory. This indicates the dimensions of the job ahead in the improvement of the state highways, without considering the amount of widening and supplementary construction that will be necessary on not less than 50 per cent of the mileage of the more durable types.

Based on an annual utilization of the highways of 128 billion vehicle-miles, the annual passenger mileage is approximately 2,880,000,000 miles. The annual loss of surfacing from the low type roads, plus the dust nuisance, means that more effective methods must be found and more largely utilized, both for holding these surfaces and for dust suppression. This is a field for bituminous construction.

There is such a tremendous mileage of roads initially improved, on which the surface is not now adequate, that a low type of supplemental construction must be developed which can be adequately maintained. As indicative of the possibilities in this field, we have a demonstration of the fine crushed rock surfaces in the West. The processing with bituminous treatments gives promise of high class service under moderate traffic at a reasonable annual maintenance cost. Furthermore, a type of maintenance is possible that renews the original smooth riding qualities of the road. It has already been demonstrated that these surfaces can be scarified and a small amount of additional material added, that the work can be done on a quantity basis, and, which is all important, at a low cost. There may be difficulties with this type of construction, but it gives such promise that the asphalt industry, both engineers and contractors, can well afford to devote thought and effort to its perfection.

There are long mileages of roads on both the state highway and local highway systems, particularly in the regions west of the Mississippi River, on which the only hope now apparent of first class highway service lies in the development of bituminous construction. Without criticizing the efforts that are being made toward the perfection in detail of the standard asphaltic mixtures for pavement construction, the attention of the industry is directed toward the desirability and necessity of developing types of construction that can be laid more cheaply than the standard types and that will prove adequate.

Again, without thought of overlooking the desirability of the more durable types of construction the attention of the industry is directed toward the overwhelming physical problem confronting the country, which cannot be met quickly by the relatively small mileages of the high cost construction that may be built with the present income from year to year. It does not appear impossible to develop processes, and the bituminous processes seem most adaptable for the purpose, that lend themselves to a complete overhauling at intervals, and through such overhauling largely restore the road to its original condition without impossible expense.

Finally the performance of many of the older bituminous macadam roads, particularly in the Northeastern states and abroad, provides confidence that this type of construction can be used under heavy traffic provided the design and maintenance are adequate. In this field there seems to lie the possibility of more closely controlled manufacturing processes, coupled with changes in design, that would insure more uniform and more satisfactory results.

* * *

Gravel and Stone Bases for Asphalt Wearing Courses

By E. N. Seymour
Engineer in Charge of Asphalt Work,
Georgia State Highway Commission, East Point, Ga.

ON THE Georgia highway system we have completed 256.29 miles of various types of asphalt surfacing on gravel base and 214.08 miles on stone and slag base and have projects under construction totaling 64.61 miles on gravel base and 7.11 miles on stone and slag base. Under our specifications we allow the use of slag where stone is specified so that no distinction is made in the base constructed of these materials; therefore the total mileage is shown as one type. Under the mileage of gravel base we have included both local and imported clay-gravel, artificially mixed clay gravel, chert and pebble soil. The selection of the type of base has been governed by the location of the project with respect to the source of supply of the base material, the idea being to take advantage of the smaller cost of local materials where possible.

Chert Bases—In the northeast corner of the state there are deposits of chert within hauling distance of the state highways. This material consists of about 25 per cent to 35 per cent binder passing the 10-mesh screen and 65 to 75 per cent hard rock retained on the 10-mesh screen. It is all

run through a crusher and crushed to pass a 1½-in. screen. Our present practice is to construct the base, immediately after the grading is completed, for a width of 19 ft. with a compacted thickness of 8 in. The chert base acts as a wearing surface during the period required for settlement of the embankment or, in case funds are not available for a completed pavement, it is used until additional funds become available. Before any asphalt surfacing is placed the base is reshaped and additional material added to give the full 8 in. compacted depth. The cost of this type of base varies from about $0.45 to $0.90 per square yard depending on the distance the material has to be hauled.

Stone Bases—In the north central and northeastern sections of the state, there are numerous deposits of limestone, granite, marble, dolomite and trap rock. The material is required to shaw a French coefficient of wear of not less than 6 and is graded in size from ¾ in. to 2½ in. Practically all of the stone base is sand-clay bound. The stone is placed on the road in a uniform layer in such thickness as to secure the proper compacted thickness, then a sufficient amount of sand clay, not in excess of 30 per cent, to fill the voids is placed on top. This is then mixed into the stone by harrowing and rolled until it will not compact further.

This type of base is usually constructed 19 ft. wide with the compacted depth varying from 6 in. to 8 in. depending on the class of material in the subgrade and the thickness is determined in each case by careful study. With this base it is necessary that the asphalt wearing surface be placed as soon as the base is completed, as the macadam does not make a satisfactory wearing surface. The cost varies from $0.90 to $1.10 per square yard.

Gravel Bases—Practically all of the base construction for the southern section has been of clay gravel shipped from outside sources. This is due principally to two reasons, one being favorable freight rates and the other the fact that during the early stages of the road building in this state, a great many miles of gravel roads were constructed and the original investment on these roads is saved in part by utilizing all the gravel remaining and adding a sufficient amount to secure the required thickness of base.

The reshaping is usually accomplished by scarifying, then smoothing with heavy road graders and compaction is secured by traffic with almost constant machining. Where the irregularities are comparatively small, it is not always necessary to scarify, but the proper surface can be secured with a heavy road grader provided the gravel has sufficient moisture. Where additional material is placed it is necessary to scarify so that the old and the new material are bonded together. In any case it is very important that all loose material be thoroughly compacted under traffic before the asphalt surfacing is added.

The clay gravel base can be utilized as a wearing surface until a more permanent surfacing can be placed and can also be placed immediately after the roadway is graded and can be reshaped later after the embankment has settled and before the more permanent surfacing is added.

The gravel base is constructed to a compacted depth of from 6 in. to 8 in. depending on the subgrade material, and the cost varies from 70c. to $1 per square yard.

* * *

Cost and Service of Asphalt Surfacing on Low Cost Roads

By C. N. Conner

Chairman, Low Cost Improved Roads Investigation, Highway Research Board, Washington, D. C.

THREE methods of bituminous treatment of secondary type roads are considered: (1) Surface treatment, (2) mixed-in-place method and (3) premixed method, either hot or cold.

Surface Treatment—The materials are a cold bitumen for the first, or prime coat; generally a cold tar, a cut-back asphalt or low viscosity road oil. The second application may be a second prime coat of the same bitumen. The seal coat is generally a heavier bitumen such as a hot asphalt, hot tar, a cold cut-back asphalt or a heavy road oil. The aggregates for cover material range all the way from a coarse clean sand to ¾-in. stone or slag.

Construction consists of: (1) Cleaning the base. (2) The application of a prime coat of low viscosity bitumen. (3) Ten hours to several days to allow penetration. (4) A second prime coat of the same bitumen for the more porous bases. (5) A light cover may or may not be used on the prime coat. Better penetration results when not used, as the cover takes up some of the bitumen. Traffic requirements may make the cover necessary. (6) and (7) The last application of the heavier bitumen and cover of sand, gravel, stone or slag. The so-called inverted penetration method means that the bitumen is applied before the final cover. The inverted method is the more common practice. (8) The surface thus formed may or may not be rolled. Best practice calls for rolling with a light or heavy power roller. A heavy roller should not be used on a relatively soft aggregate. (9) Seal coats or a third application are some times used to seal the surface, if open, or to build up a greater thickness.

The skin surface treatment for the first year will cost from $1,000 to $2,500 per mile for an 18-ft. width. When serving within its traffic capacity the annual surface maintenance cost does not exceed $1,000 per year under unfavorable weather conditions. Under favorable weather conditions and on excellent bases the maintenance cost for a road treated by this method will not exceed $500.

The traffic capacity of this type under favorable conditions of base and climate is probably 2,000 vehicles per day, without excessive maintenance. Higher capacities have been reported. A fair average traffic capacity on gravels and top soils is from 800 to 1,500 automobiles and light trucks. A higher limit may be reached on lime rock or stone macadam bases.

Mixed in Place Method—Either asphalt or tar has been used. In a few instances both have been used. They range all the way from fuel oils as used in California to cut-back asphalts in North and South Carolina and tars in Wisconsin. The bitumen should be such that it will not become sticky or "set up" until sufficient time has elapsed for the necessary manipulation of the mixture. The road oils which do not contain a solvent set up more slowly than the cut-back asphalts. They also leave a more plastic mixture. The surfaces which contain such aggregates as crushed or screened gravel and crushed stone have generally been selected for treatment. There is evidence, however, that poorer materials such as sand clay may be thus sufficiently stabilized and the traffic capacity increased.

The construction processes are: (1) Smooth the existing surface. (2) Scarify if necessary, harrow, machine and shape. (3) Apply first coat of cold bitumen and mix with harrow and road machine blade. Sometimes harrowing is omitted. Blading is seldom omitted. (4) Apply a second coat of bitumen and mix thoroughly. (5) Sometimes a third coat is applied followed by more mixing. (6) Mixing is continued until a uniform color results. (7) Following a final shaping with a road blade or a drag the surface preferably is rolled for final compaction with a power roller. Some engineers secure compaction by traffic. (9) A seal coat may be used if needed. An open surface may indicate this necessity or a lean base may be the indication.

These surfaces are built as thin as about 1 in. and as thick as 3 in. Maintenance may include seal coats or patching with a mixture of aggregate and bitumen. If the original mixture was too lean, a remixing with more bitumen may be indicated; if too rich, a remixing with more aggregates may be the solution.

For an 18-ft. width of treatment the cost will range from $1,100 to $1,200 per mile to $5,000 or $6,000. The class of bitumens used as well as the depth of treatment will affect the cost. Most of the surfacing has been on gravels and stone roads. The first cost for these has averaged less than $2,000 per mile.

Some of these surfaces are carrying a counted traffic of between 1,000 and 2,000 vehicles per day without signs of serious fatigue. The surfaces are smooth and comfortable to ride upon, much smoother than the average skin surface treatment or rolled hot top. The mixed-in-place surfaces

may be built without serious interruption to traffic and the inconvenience of heating operations.

Premixed Method—If the applied surface mixture is to be less than about 1½ in. in thickness and the base is porous or semi-porous, then a prime coat of suitable cold asphalt or tar is recommended. A binder course of "black base" or a thin course of penetrated stone will add to the stability and assist in keying the top to the base. In one state, Michigan, both the prime coat and binder course are used on gravel base. The top course is a stone-filled sheet asphalt or fine aggregate type. The construction of the top itself varies very little from standard methods. They include proper dumping, spreading, raking, patching and rolling. Final compaction by rolling must be secured in less time for the hot mixes than for the cold.

The aim in this class of surfacing is to secure a surface which will cost less than $1 per square yard, or about $10,000 per mile of 18-ft. width. Rock asphalt has been laid in Texas for a ½-in. depth at $3,700 per mile; 1-in. for $5,400, including a prime coat of oil. In Michigan a prime coat of tar, a light binder course and a 2-in, Topeka top is costing around $13,000 per mile. Some work in Georgia using about 2 in. of penetrated stone and about ¾-in. sheet top cost approximately $12,000. When local materials may be used as aggregates the costs have been considerably reduced for the hot mixes. There are little cost or usage data available for hot or cold premixed surfaces of 1 in. and less in thickness.

The traffic capacity of these types on substantial bases has been estimated and counted as between 1,000 and 2,000 vehicles per day. Some are carrying more. This type of surfacing is not as smooth to ride over as the mixed-in-place surfaces. The cold mixes have some apparent advantages over the hot mixes. This advantage is apparent principally during the construction period. There is less interruption to traffic, less expensive equipment is required, and cost of plant operation is reduced.

* * *

Asphalt Surfaces for Reclaiming Concrete Roads

By V. L. Ostrander
Albany, N. Y.

IN SALVAGING old concrete various standard asphalt surfacings have been found practicable. Thin mats filled with stone or gravel have been successfully used for temporary relief, while both penetration macadam and the hot or cold mixed asphaltic concretes have been placed for more lasting rebuilding. The New York state highway department has given 203 miles of concrete pavement a thin mat, while 222 miles have been heavily resurfaced.

The thin mats range from ¼ in. to ⅝ in. thick and are used as an immediate means for arresting scaling and disintegration. They have been formed by various means. Heavy 85 per cent to 90 per cent asphaltic oil has been used, as also have asphalt cut-back, macadam binder of 100-120 penetration and paving asphalt of 50-60 penetration. Always these applications have been covered with stone or gravel to about the extent they would absorb. It is essential that the cover be rolled in.

For jobs of considerable length where it is desirable to apply a whole distributor load of asphalt as fast as possible, the asphalt cut-back method is quite satisfactory. It gives an opportunity for spreading and thorough rolling in of the cover stone before the asphalt has become too hard to absorb it readily. Two applications, of about ¼ gal. each with as much ¾-in. stone cover as may be rolled in, are preferred. The second application may follow the next day after the first or may come some days later.

On work where thorough cleaning may be accomplished and where conditions permit covering and rolling as fast as the hot asphalt is applied, a primer coat of asphalt cut-back followed several days later by about ½ gal. of paving asphalt with ¾-in. stone cover has given excellent results. These mats are thin and require patching each year to care for small spots that become loosened. A general treatment about every third year is necessary.

Heavier resurfacing with penetration macadam has been used in widely scattered sections with uniformly good results. Maine has used it in covering disintegrated concrete on the principal seaboard route between Portsmouth and Portland. Massachusetts has used it in the highly industrial territory between Boston and Providence, while New York has used it in many places. On the main line between New York and Montreal just north of Schroon Lake is a good example of the protection a macadam surface will give to a poor base. This road was originally a 6-in., 1-2½-5 mix of gravel concrete and was completed about 1914. It was at once evident that this pavement was not of a standard that would last any time at all and steps were at once taken to cover it with a new macadam top. This was completed in 1916. There was so little bond in the concrete that the aggregate was being thrown off the sides, with holes scattered throughout where water stood. It is certain that there would not have been a vestige of this old concrete left at the end of two years, possibly one year. But the 3-in. macadam surface placed at a cost of $6,500 per mile has brought the road along for the past eleven years in a most satisfactory manner and is good for many years yet.

Most of the various mixed asphalt types have been successfully used. These include both hot and cold mixtures, cut-backs and emulsions. Each has been selected through some local preference or condition that seemed to point to its favor. Thicknesses ranging from 1 in. to 3 in. are used, above 2 in. being usually secured through the use of a binder course which experience has shown to be necessary when the old concrete surface is uneven.

Generally it is not necessary to replace any great volume of concrete in order to make it ready to receive the new top. A concrete pavement may be so disintegrated and of so little bond as to be readily pulled apart with a pick point and still be salvaged for a considerable volume of traffic. Where the failure is due to cracking and breaking, it is frequently necessary to replace considerable concrete to restore a condition of uniformity. Discretion is necessary in deciding when broken concrete, perhaps sunken slightly, should be removed and when it may be safely built up to restore the surface uniformity.

In connection with the preparation of these bases to receive new hot tops there is one feature that sometimes has escaped attention. Of course it is usual to remove as much of old patching mats as possible to avoid later fat spots. It is also essential that any transverse or longitudinal joints that have been filled with bituminous joint filler be cleaned out to a depth of ⅝ in. or more before placing the binder course. This is to prevent any lifting of the binder due to expansion of the material in the joints. This lifting is almost sure to happen if the joint filler is not removed and it can be easily prevented by such removal.

A considerable yardage has been built with concrete edging or flush curb, while a still greater yardage has been built with no edgings or side support other than the natural shoulder. Concrete edgings have not been entirely satisfactory. They are frequently the cause of insufficient consolidation of the black mix along the edges due to the roller riding on the edging. They may become slightly displaced through heaving or by heavy load concentration or other cause. When this occurs the slight opening alongside permits water to collect under the edge of the black top with a resultant harmful effect.

There has been a generally successful result where no support other than the earth shoulder has been used. Of course temporary forms were used during construction but immediately taken out and moved ahead. To my knowledge there have been no instances in the Northeastern states where plank edgings have been left in place after construction, as I believe has been done in other parts. At times a small battered edging of binder mix has been tamped along the edges of the top course to give some additional lateral strength. While there may be minor breaks along the edges of these tops from time to time they are of little moment and easy of repair. It would seem from past experience that unless the pavement is so narrow as to force considerable traffic to the extreme edges it is unnecessary to build concrete edgings for side support.

Right to Underground Water Sustained by Court

Arizona Decision Recognizes Prior Right of User Even When Bed and Banks of Underground Channel Cannot Be Located

By Daniel W. Murphy
Consulting Engineer, Los Angeles

A DECISION was recently handed down by the Superior Court of Maricopa County, Arizona, Joseph S. Jenks, presiding judge, in which the right of well owners to a flow of water in an underground stream is recognized regardless of inability to locate the boundaries of the underground channel. The suit was brought by the Southwest Cotton Co. and other subsidiaries of the Goodyear Tire & Rubber Co. against the Maricopa County Municipal Water Conservation District No. 1, et al. Defendants had constructed a reservoir by building the Frog Tanks (Lake Pleasant) dam on the Agua Fria River where the waters of this stream are to be stored and used for irrigation. The purpose of the suit was to quiet title to right to both surface and underground waters in the Agua Fria River and to restrain defendants from cutting off or diverting those waters from plaintiffs' lands.

The Agua Fria River debouches from the mountains about 30 miles above its junction with the Gila River. Throughout this distance it flows over a broad, sandy bed. Evidence showed that during periods of extreme floods, estimated at 100,000 sec.-ft., about 9,000 acres of river bed are submerged. At the point where the river debouches from the mountains surface flow is practically continuous. Surface water reaches the Gila, however, only during flood periods, the smaller flows all being absorbed.

Plaintiffs contended that the water absorbed in the stream bed was the source of supply for their wells located over several thousand acres of the valley and on both sides of the Agua Fria River. It was contended further that this underground flow followed a definite underground channel or channels from the points where it was absorbed to the Gila River, and that this channel or waterway was composed of pervious sands and gravels deposited by the stream in the process of building up the valley; also that there was no other source adequate to supply the water pumped from plaintiffs' wells.

Defendants contended that the water being pumped from plaintiffs' wells was not from an underground stream but diffused or percolating water; that it was impossible to locate bed or banks of the alleged underground channel; and that the valley fill under and adjacent to the Agua Fria River consisted of a heterogeneous mass of various sorts of materials not deposited in such manner as to form an underground channel or channels.

The court ruled that there could be no other reasonable conclusion than that an underground stream flow exists. The finding was that impervious bed and banks are not an essential to an underground stream, and that the less permeable materials which border the underground stream may be regarded as forming its bed and banks.

"It does not seem reasonable," the court ruled, "that it should be necessary for underground streams to have impermeable beds and banks any more than for surface streams to have them. Surface streams seldom have beds and banks which are impermeable. It is only in the upper reaches of mountain streams which are constantly wearing away the rocky material composing their beds and banks and carrying it to the plains and valleys below that such conditions exist. The beds and banks of surface streams are as a rule very permeable and serve only incidentally to support the flow of water. It is their saturation and the saturation of the material underlying and surrounding them which supports the flow of water. In the absence of such saturation the water, seeking its level, sinks into the ground.

"And so it is with the ordinary underground stream passing through detrital matter; if there be a flow of water through such material apart from the indiscriminate oozing and seeping of the water generally throughout the mass, it must be due to the presence of material in channel formation of greater permeability that that of the surrounding material. Nevertheless, such more permeable material would not support a stream flow any more than would the beds and banks of surface streams unless the surrounding less permeable material were saturated with water, and so it may be said with equal propriety that such less permeable material surrounding that of greater permeability constitutes the beds and banks of underground streams."

* * * * *

"All that is necessary to a stream is continuity of flow," the court ruled. "Given continuity of flow and there must be beds and banks to support it. This is recognized by Mr. Kinney when he says (2 Kinney on Irrigation and Water Rights, 2nd Ed. 2105, Sec. 1161): 'However, it is held that the channels and existence of such [underground] streams, though not visible, are "definite" and "known" within the meaning of the law, when their course and flow may be determined by reasonable inference.'"

The court held that plaintiffs had established a prior right to the taking and use of water from the underground stream. In addition to providing the quantity of surface flow to which plaintiffs have acquired a prior right the decision requires defendants to maintain the water table under plaintiffs' lands at such elevation that plaintiffs can take therefrom the quantity of water, for which prior right has been acquired, with its present pumping equipment. The following is quoted from the decision:

"Plaintiffs' heading in this instance is the level of the underground water body at which their pumps will operate to raise the supply appropriated without lowering them, unless the natural flow of the river, if allowed to come down as heretofore, should be insufficient to sustain it at such point, in which event it would be at such lower level from time to time as the natural flow would sustain, taking into consideration, of course, the draft upon the underground supply due to the operation of pumps.

"Defendants' duty, as established under the decree to be entered in this case, will be to maintain that heading. The court will, of necessity, retain jurisdiction of the case in order to take evidence and determine as may be required where plaintiffs' heading should from time to time be established, and the point below which defendants may not permit the water level to drop."

Air Mail Routes in United States

The 25 air mail routes now operating or to operate in the United States in the near future under contract or advertised will serve trading areas along these airways with a population of 62,299,409 persons, with 79 station stops, according to the Aeronautics Branch of the Department of Commerce. There are fifteen routes in operation at the present time, with a route mileage of 7,997. Commercial routes bring the total route distance to more than 12,000 miles.

Foundation Problems in Enlarging Center Pier of Swing Bridge at Providence

Plan to Enclose Old Pier, Point St. Bridge, in Steel Cofferdam Driven Into Quicksand, and to Concrete in Dry Proves Unsuccessful—Experts' Reports and Recommendations

By G. W. Maker
Waverly, Mass.

REPLACEMENT, with a new structure, of the swing span of the Point St. Bridge, which provides a crossing of the Providence River on an important traffic route about one-half mile below the center of the city of Providence, R. I., developed into an engineering and construction operation of first magnitude. The major problem was the enlargement of the old center pier to carry the increased weight of the new span, an undertaking made more difficult by uncertainties as to its foundation conditions.

After the original plan of construction had resulted in serious settlement of the old pier, consulting advice was sought from three foundation experts, all of whom

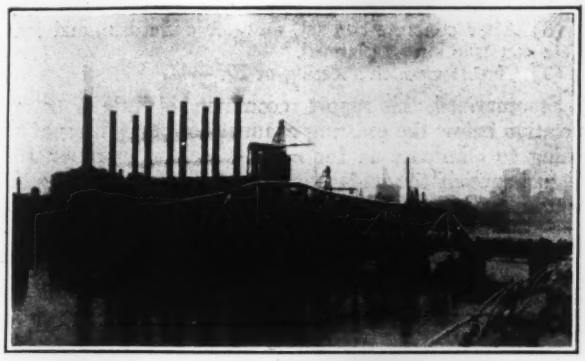


FIG. 1—OLD STRUCTURE, POINT ST. BRIDGE, PROVIDENCE, R. I.
Center pier was enlarged to carry a new, longer and heavier span.

rendered reports covering soil characteristics and action, and recommending changes in the construction procedure. The final adopted plan discontinued the driving of steel sheeting inclosing the old pier, which had caused serious agitation of the quicksand formation; provided for dredging about 1,000 yd. of material and for cutting off the new wooden piles by divers; specified the pouring of the lower 12 ft. of reinforced concrete by tremie, whereas the original plan contemplated all dry concreting; and permitted the immediate removal of the old swing span, which under the old plan was to have been maintained for traffic until the new center pier was enlarged. Under this modified procedure, the work was successfully completed, and the bridge opened to traffic Aug. 15, 1927.

History—An original bridge was condemned in 1871, and about a year later a new bridge was constructed consisting of two 145-ft. shore spans and a center swing span 249 ft. long. This structure continued in use until 1907, when each of the 145-ft. approach spans was divided into three plate-girder spans carried on new granite piers and abutments, and the swing span was increased in length to 284 ft. This design gave a 40-ft. roadway and showed a 10-ft. sidewalk on either side, carried on steel brackets. Funds, however, were not sufficient to include the replacement of the swing span, and since the effective width of the structure was limited to the width of the old swing span, the sidewalks, as designed, were omitted, and constructed within the 40-ft. roadway, still leaving an effective road width as great as that of the old swing span. The piers supporting the old draw were left in place and connected by a short wooden span to new piers located to take the ends of the new draw.

In 1924, it became apparent that improvement was imperative, and in April, 1925, the city was authorized to borrow $400,000, later increased to $550,000, for the completion of the bridge. Early in 1926, bids were taken and contracts awarded. The work was divided into three principal contracts: (1) widening the approach roadway to 40 ft. and adding the sidewalks as originally designed; (2) reconstructing the center pier to carry the much greater weight of the new swing span; and (3) fabricating and placing the swing span. This article will consider only the reconstruction of the center pier.

First Reconstruction Plan—The reconstruction of the old center pier involved many uncertainties. This old pier was of masonry, 30 ft. 6 in. in diameter at the top, supported on a timber platform carried by wood piles, the length of which was unknown. There was, in fact, little or no reliable information covering the construction of the old bridge, built more than fifty years previously. Specifications called for the removal of the top of the old masonry pier to El. —5.5 (0. = M.H.W.), construction of a new reinforced-concrete ring around the old pier to increase the diameter to 49 ft. at the top, and capping both old and new construction with a heavily reinforced concrete mat built up to El. 1.75. The new concrete ring was to be carried to El. —29.75 (16 ft. below the bottom of the old pier and about 8 ft. below the bottom of the channel) and was to rest on wood piles. The upper 8 ft. of the new construction was to be faced with granite. In order to protect the old pier, a ring of steel sheetpiling was to be driven close to this pier, this piling to be cut off at the top of the timber platform, at El. —12.30. It was particularly specified that "sheetpiling and bracing must be of heavy construction to maintain the present pier in a stable condition and allow the drawbridge to be turned while the work is being done."

The procedure as called for by the specifications was to dredge as much of the excavation around the old pier as was safe, drive the inner ring of sheeting, drive the wood piles around this sheeting, and complete the cofferdam by driving the outer ring of sheeting. The cofferdam would then be unwatered, excavated to the proper grade, wood piles cut off and concrete placed. The specifications particularly stated that "no concrete shall be placed under water."

Construction was started in accordance with this plan, approximately 200 yd. of material being removed by an orangepeel bucket, before driving started on the 45-ft. lengths of 14-in. 40.8-lb. arch-section piling. The requirement that the operation of the bridge must not be interfered with made this work difficult. A 1926 report

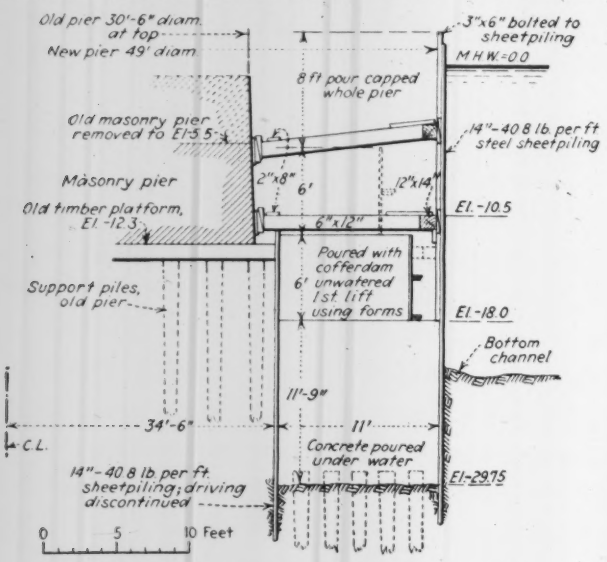


FIG. 2—METHOD OF PIER ENLARGEMENT, POINT ST. BRIDGE

showed a daily average of 12 openings of the bridge, and this constant interference made it impossible to set up the complete ring of sheeting, only one pile at a time being driven. From the start, the pier showed settlement which, as the driving continued, increased until it was no longer possible to maintain the bridge level by adjustment at the center pier. The span, which had previously swung in a full circle, could then open only in one direction, and, when in open position over the cribs, the downstream end was 28 in. below the upper end. The driving of this inner row of steel sheeting, therefore, was discontinued with still about 10 ft. to go. Since there seemed little doubt that settlement would continue with the driving of the wood piles and the outer ring of steel sheeting, experts were called in to advise respecting the dangers which might be involved in carrying out the work as originally planned. These experts were Charles R. Gow and J. R. Worcester, consulting engineers of Boston, and Dr. Charles Terzaghi of the Massachusetts Institute of Technology.

Mr. Gow's Report—Borings were taken by Mr. Gow, whose report stated that the underlying material was quicksand, and similar to the material which he had found, by experience, to be the principal subsoil underlying the greater part of the business section of Providence. This report pointed out that while such material, in an undisturbed state, is capable of supporting substantial loads, when agitated it tends to become unstable, assuming fluid characteristics, and that the vibrations, imparted in the process of driving the piles, had caused such an agitation. Modification of procedure, as a safety precaution if the bridge were to be continued in use, was urged.

The report stated that a 30-ft. hydrostatic head of water would undoubtedly cause violent boiling of the quicksand, should an attempt be made to unwater the proposed cofferdam, and that such an occurrence would cause serious damage to the old pier, rendering it impossible to complete the work in the open. It further pointed out that, when the pier was constructed in 1872, the piledriving art was in rather a crude state, and that, with methods and facilities then available, it was improbable that the piles under the pier had been driven more than 10 or 12 ft. Accordingly, if the new construction were carried out as planned, excavation would extend below the tips of these old piles, leaving the pier and draw supported merely by a cylindrical prism of very unstable material.

For the above reasons, Mr. Gow recommended that procedure be modified as follows:

(1) Do no more driving of the steel sheetpiling surrounding the present pier.
(2) Excavate around present pier to El. —18.
(3) Install foundation piles as planned, excepting that second row from the outside be driven with an outward batter of $\frac{3}{4}$ in. per foot.
(4) Saw these piles off at El. —16.
(5) Use diver, with water jet, to remove any accumulation of sand from around upper 2 ft. of piles.
(6) Drive cofferdam of 6-in. tongued-and-groved wood sheetpiling, inclosing site with interior diameter of 56 ft. 5 in. (maximum diameter of new construction at base).
(7) Place 6 ft. of concrete by tremie method.
(8) After concrete has set, unwater cofferdam, and complete construction as planned.
(9) Cut off wooden sheeting at El. —11.

Summarized, this report recommended little or no excavation below the existing channel bottom, jetting of all piling to eliminate as far as possible the vibration and disturbance of the underlying quicksand, and sealing the bottom of the cofferdam with 6 ft. of concrete before unwatering.

Mr. Worcester's Report—The report of J. R. Worcester recommended that the excavation be done by

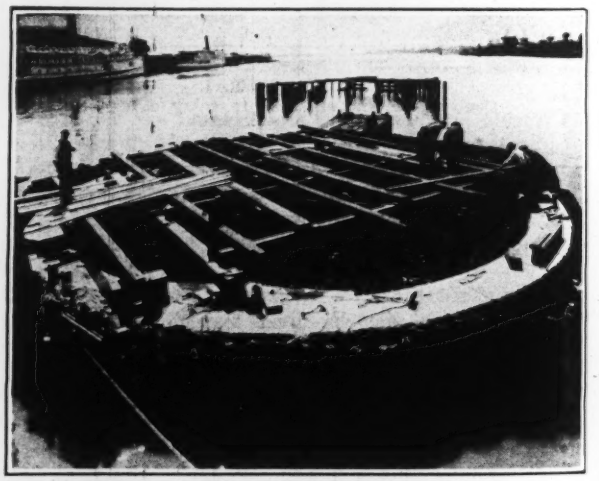


FIG. 3—PLACING STEEL FOR CAPPING MAT OVER ENLARGED PIER
Granite facing used for concrete forms.

pumping, after the cofferdam was driven, maintaining the water at balanced head, but replacing the resistance, lost when the material was removed, by ring tension which he calculated at 31,000 lb. per vertical foot. Mr. Worcester's recommendations follow:

(1) Stop further attempts to get the steel sheeting down.
(2) Drive (or jet) the new wood piles.
(3) Drive outer sheeting.

(4) If these operations have not caused further settlement of the old pier, proceed to excavate, replacing ring tension by the help of divers.

(5) As soon as any sign of disturbance of the old pier occurs, stop excavation and seal bottom of excavation with concrete deposited through a tremie.

(6) Do no dewatering until bottom seal is set.

Dr. Terzaghi's Report—The investigation made by Prof. Charles Terzaghi included new borings, a laboratory analysis of samples from these borings, and consideration of the different matters in question, from a practical as well as a theoretical viewpoint. The original borings, which were shown on the city's plans and on which bids were based, were of indeterminate age and origin, and indicated a mixture of sand and clay. Dr. Terzaghi pointed out that, if this indication were correct, no harm could occur from simply driving piles around the site, and that the mere fact that the piledriving operations caused settlement showed that the interpretation of the results of these old borings "was not quite consistent with general practice." Borings made by Mr. Gow indicated a microscopic sand down to El. —50 or —56, below which the material was what is commonly termed hardpan. When new borings were made under the direction of Dr. Terzaghi, it was noted that the action of the material was characteristic of quicksand.

At three points, El. —30, —40 and —50, the washpipe was withdrawn from the casing, and a dry sample of the material obtained by driving a 1-in. pipe to a depth about 2½ ft. below the lower end of the casing. When this sampler was removed, the lower end, filled with material, was disconnected, and both ends of the short section were sealed with cardboard and melted paraffin in order to preserve the sample with its original water content in an undisturbed condition. These samples were subjected to laboratory tests to determine the relative volumes of voids in the undisturbed material and after slight but continued shaking. All samples were mechanically analyzed by elutriation, and by examination under the microscope, while one sample was subjected to the standard swelling test. As a result of this investigation, Dr. Terzaghi stated definitely that the material was a typical quicksand, exceedingly fine, with an effective size ranging from 0.015 to 0.006 mm., with a uniformity of hardly more than 5.0, and having the characteristic that the volume of voids, which, for the sealed samples, ranged between 39 and 42 per cent, could by shaking be reduced to values running between 31 and 34 per cent. This reduction in volume explained the movement of the pier when the steel sheetpiles were driven.

In reporting on proposed construction procedure, Dr. Terzaghi stated that excavation between the two rings of sheeting might be carried down to El. —29.75, as proposed, only if the water level within the cofferdam were kept at least 1 ft. above the outside level, to prevent washing of material from within the inner row of piling, and only if the inner ring of piling were sufficiently anchored, in itself, to withstand a horizontal tangential stress of about 15,000 lb. per ft., corresponding to a horizontal internal pressure of 850 lb. per sq.ft. Failing to maintain these conditions, the pressure exerted by the quicksand within the enclosure might be expected to result in spontaneous, sudden movement with possible serious results. As to the practicality of cable ties to prevent bulging of the inner ring, Dr. Terzaghi expressed the opinion that . . . the placing of the ties at a considerable depth below the water level would represent a very difficult and delicate piece of work, due to the fact that the inner row of sheetpiles is very irregular, presenting angles and corners instead of being true to a circle. Unless the ties are circular and thoroughly wedged, they would stretch under the influence of a radial pressure, which in turn would lead to disturbing the core of quicksand contained within the inner row of sheetpiles. In the matter of a 6-ft. concrete seal, assuming excavation to have been carried down to El. —29.75, he recommended tying this seal to the steel sheeting in order to utilize the resistance of the sheeting against pulling.

Finally, because the joints of the inner row of sheetpiles seemed to be in places fairly wide open, there existed a danger that, while pumping out the annular space, the quicksand would flow out of the open joints, thus producing cavities behind the sheetpiles. The cavities in turn could lead to spontaneous settlements within the core of quicksand on which the existing pier rests. This possibility, Dr. Terzaghi stated, represented the most objectionable feature of the proposed procedure.

Final Reconstruction Procedure—At a conference including Messrs. Gow and Worcester, Dr. Terzaghi, and representatives of the city and the contractor, it was agreed to modify the procedure. The city agreed to close the bridge to traffic and remove the draw immediately, and to permit the lower 12 ft. of the new ring to be placed under water. Work proceeded on this basis.

Wood piles and the outer ring of steel sheeting were jetted into place. The material within the cofferdam was agitated by jets and pumped out, approximately 1,000 cu.yd. being removed. Piles were cut off by divers at El. —28. The first assembly of reinforcement, about 6½ tons, was fabricated above water, and lowered into place. The first lift of concrete, a total of 675 cu.yd., was placed as a continuous operation in approximately 40 hr., using ½-yd. bottom dump buckets. This pouring brought the concrete up to El. —17, slightly above the bottom of the channel. The cofferdam was then unwatered, the laitance removed from the top of the lower ring, and the balance of the ring placed in three lifts of 6 ft., 6 ft. and 8 ft., the last pouring constituting the cap over the whole pier, and involving the placing of approximately 400 cu.yd. as a continuous operation. The 8-ft. granite facing around the top of the pier was set in place, and served as the outer form for the last pouring of concrete.

The new draw span, weighing 1,536 tons, was fabricated on piers about a mile below the bridge, placed on lighters and towed into place. The bridge, as stated, opened to traffic Aug. 15, 1927.

Plans for this work were developed by the engineering department of the city of Providence, and the work carried out under the supervision of Frank E. Waterman, commissioner of public works. The contractor was the W. V. Polleys Co., Providence, R. I.

U. S. Foreign Trade in Cement

Cement imports into the United States totaled 221,274 bbl. valued at $321,777 during October, 1927, a quantitative decrease of 16 per cent compared with October, 1926, when imports were 263,403 bbl. valued at $386,335, according to figures of the Minerals Division of the Department of Commerce. Corresponding figures were 67,639 bbl., $2,556,827, this October, 69,389 bbl., $225,974 in October, 1926. Totals for the ten months ending October were: Imports, 1,751,629 bbl., $2,556,827, 1927, and 3,042,973 bbl., $4,799,894, 1926; exports, 674,861 bbl., $2,312,330, 1927, and 803,652 bbl., $2,452,492, 1926.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Portable Hand-Operated Elevator Truck Erects Steel Beams

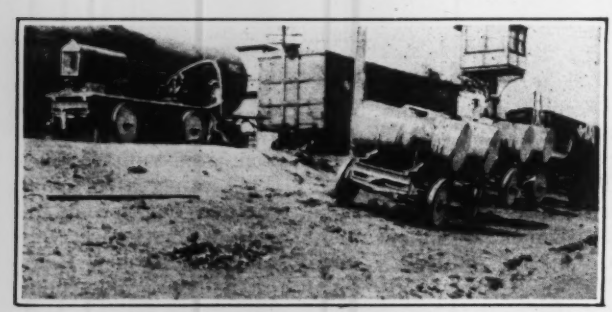
DURING the erection of the structural steel for a new plant addition for the Lewis-Shepard Co., Boston, a number of material stackers or portable elevator trucks manufactured by the company were ingen-

HAND-POWER PORTABLE STACKER RAISING I-BEAM

iously used. As shown in the accompanying illustration, two hand-power machines raised the I-beams into position. Two men did the work, and only a few minutes were required to place a beam in position. The new building will provide the company with 15,000 additional sq.ft. of production space.

Tank Trailers Used for Hauling Bituminous Materials

THE Virginia State Highway Department is confronted with the problem of the bituminous surface treatment of gravel roads that are as much as 90 miles from the nearest railroad station. To haul all of this material in the distributor would mean loss of time and additional cost. To overcome this two 350-gal. tanks were installed on trailers. At first the trailers were pulled by a small rubber-tired tractor, but this was found to be too slow. The trailers were then pulled by trucks. Two other tanks were installed on the trucks and double the quantity hauled in less time. The distributor was loaded and sent to the road to be treated. The tank units were kept running day and night to insure a continuous day-time operation of the distributor.



TANKS FOR BITUMINOUS MATERIALS LOADED ON TRAILERS FOR LONG-HAUL USE

This method of hauling material, on long hauls, proved so satisfactory that it is now used on much shorter hauls to great advantage. Distributors are built on heavy powerful trucks which must be operated rather slowly.

Heated material was transported in a like manner. It was found that the heat fell off about one degree per mile. If it was too cold when it reached the job to be applied it was easily stepped up to the right temperature in the distributor.

The leading from the tank car was done by a portable pump driven by a small tractor motor. The tanks and trailers were surplus war material.

Load Tests of Hollow Building Tile For Use As Footing Drains

IN ORDER to determine the supporting strength of hollow building tile when placed underneath concrete footings as a drain in wet alkali soil, tests were made during the spring of 1927 on glazed and unglazed block by A. Griffin, superintendent of operations and maintenance of the department of natural resources of the Canadian Pacific Ry. at Brooks, Alta., Canada. Although no footings of this type had been constructed, it was believed that deterioration of the concrete, due to absorption of water containing alkaline salts and also due to the freezing of moist concrete, could be prevented by using building tile to carry away water.

Tests were made on the "split" type of block as well as on the regular block, with both glazed and unglazed surfaces. Loads were applied perpendicularly to the 12x12-in. face by means of a hydraulic jack equipped with a pressure gage reading to the nearest 1,000 lb. The two outside and two interior ribbed walls had a total length of approximately 48 in. and a thickness varying from $\frac{9}{16}$ in. for the glazed tile to $\frac{5}{8}$ in. for the soft-burned unglazed tile. As the loads were applied, the 12x12-in. faces cracked before failure occurred, but in all cases ultimate failure was gradual and consisted of a shearing or crushing of the ribs.

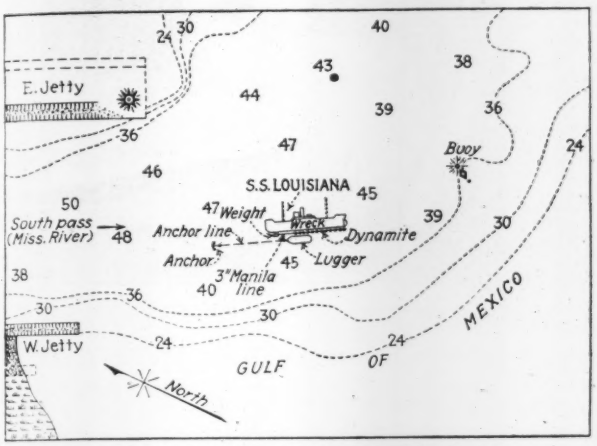
The "split" type of block had a cut extending half-way through the block on the centerline of each rib so that the tile could be split into two 12x12-in. plates with ribs on one side. The entire inner surface of the tile, including the ribs, was scored to permit better bonding concrete. These blocks were tested without being split and therefore the loads were transmitted across the split portion through only about one-half of the normal cross-section of the rib.

Complete failure occurred under pressures varying from 45,000 lb. to 80,000 lb., while initial failure occurred with a minimum pressure of 20,000 lb. There was little difference in the test results between the glazed and unglazed blocks, or between regular and "split" blocks.

Wrecked Vessel Dynamited Into Hole To Protect Navigation

By W. B. Smith
Associate Civil Engineer, War Department, Burrwood, La.

THE steamship "Louisiana," a steel hull cargo vessel 253.4 ft. long by 43.8 ft. beam, by 26 ft. deep, and of 2,674 gross tons, was rammed and sunk off the end of the South Pass jetty on Oct. 28, 1926. It was hoped that the vessel after sinking would shortly settle to a safe



LOCATION OF WRECK AND METHOD OF PLACING DYNAMITE CHARGES

depth. However, by the latter part of December, 1926, it was apparent that settlement had ceased, and an attempt was made to remove the wreck by forcing air into the hull, but sufficient buoyancy could not be obtained. This plan was therefore abandoned and bids advertised for doing the work by contract. It was then sunk and flattened out below the depth of 35 ft. after 17 days work by means of tons of dynamite.

After being rammed the Louisiana quickly filled and settled to the bottom on its starboard side, with the masts approximately horizontal and pointing toward the channel about 300 ft. from the entrance channel range and about 500 ft. from the sea end of the jetties, the stern projecting some 10 or 12 ft. above the water surface later settling to about 4 ft. above water with the bow about 15 ft. under water.

Field operations started on Aug. 16 with a plant consisting of a power-driven lugger 75 ft. long by 24-ft. beam and 6-ft. draft. The crew consisted of a master, an engineer and two deck hands, in addition to which the contractor employed a powder foreman and five laborers. Charges of dynamite were first placed on the bottom, close against the vessel and following the line of the keel from the bridge to the stern. Precautions were taken not to damage the hull, the idea being to dig a hole and allow the wreck to settle into it.

The anchor of the lugger was dropped above the wreck and the anchor line slacked off until the lugger was in proper position. A heavy weight used as an anchor was tied to a 1-in. diameter manila rope, used as a powder line and dropped overboard just above the bridge of the ship. Cases of 60 per cent straight dynamite and some gelatin were strung along this line at about 2-ft. intervals until a sufficient amount had been attached to constitute the first charge of 5,100 lb., when the line was pulled taut around the stern of the ship and the end dropped. The lugger moved off about 800 ft. and the charge was fired from a rowboat. The wreck settled about 9 ft. Water and mud were thrown in the air over 100 ft. The method of laying the charges is shown in the accompanying figure.

The following day a charge of 2,400 lb. was exploded in the same place and the wreck sunk about 3 ft. more. On Aug. 24 11,000 lb. of dynamite were exploded in the same locality. Soundings indicated the least depth over the wreck to be 8.5 ft. The contractor then increased his force to eight laborers and hired another small gasoline launch for use in firing the charges. The charge of 5½ tons was followed by smaller charges throughout the removing operations, these charges ranging from 1,000 to 3,400 lb. except occasionally when light charges of about 250 lb. were used to cut small fragments of the hull.

On Aug. 25 a charge of 3,400 lb. was exploded and the wreck sunk 3½ ft. On Sept. 1 another charge of 2,500 lb. was exploded directly over the wreck, approximately 100 ft. from the stern. This charge was intended to sever the wreck in two pieces so as to allow the forward portion to sink in the deep hole made by the current and the explosions. The contractor then worked from the cut toward the stern with light charges varying from 1,000 to 2,000 lb. These charges were placed on the wreck so as to flatten it. The main portion of the wreck was destroyed in this manner with the exception of five or six small projections by Sept. 15. The work was completed on Sept. 21, ten days prior to the time limit for completion as specified in the contract.

Charges were placed at all times by tying the dynamite to a rope but after the first charge sacks instead of packing cases were used to hold the dynamite. About 28½ tons of explosives were used and none of the surrounding lighthouse buildings nor jetties was in the least damaged.

The work was under the charge of the Corps of Engineers, U. S. Army, Major Malcolm Elliott, District Engineer, with the writer in local charge of operations.

Protecting Railway Improvement Work Under Traffic

THE following is an abstract of a committee report presented at the recent convention of the American Railway Bridge and Building Association:

Through our investigations we did not find that there are any established rules and practices covering the protection of men doing work under traffic. They will get as much protection as the management demands or the men will take. The supervisory officer has the responsibility of seeing that the men understand and obey orders, and the behavior of the foremen depends upon him. Foremen should be required to pass written examinations as to their work, and a gang under a competent foreman will get necessary protection.

Work to be done under traffic must be carefully planned, programmed and scheduled. Generally, climatic conditions will be the ruling factor in scheduling bridge and building work, but traffic conditions may outrate seasons in setting the schedule. The work should be scheduled to be done when the traffic is the lightest and then the problem of protecting men is partially solved.

Near cities there are often periods during the night when few or no trains are scheduled. Good lighting systems now available make it possible to furnish proper illumination for almost any character of work, so that it will be economical and safe to fit the work to train schedules, although it will throw the working hours into the night.

Tunnel work that has to be done under artificial light is often done during daylight hours when train schedules are unfavorable, but such work should be fitted to the train schedules. Renewal and maintenance work around highway and street crossings, under-grade and over-grade electric crossings, passenger terminals, shops and around any structure or facility can best be scheduled at night or when such facilities are being used little or not at all.

Most work has to be done under more or less traffic, no matter how carefully planned and scheduled. Train orders may be issued, directing trains to move under control in approaching the work. Telephones enable station operators to notify watchmen of approaching trains, and for tunnel work these watchmen may then operate electric signals warning the men. On an extensive job of bridge renewal, a manually-controlled block was established, with an operator at each end. One responsible man saw to it that the men were clear and the track unobstructed before trains were given the signal to proceed. Such a system is expensive to install and operate, but its use is justified under heavy traffic.

In obscure locations, such as on sharp curves, in tunnels, cuts or alongside buildings or in any place where approaching trains cannot be seen for some distance, the prevailing practice is to station lookouts to warn the men of approaching trains. Lookouts are also stationed where men are at work taking down trees or loose over-hanging rocks. It is to be assumed that protection by flagging, according to standard rules, will be given where the men cannot get clear of trains quickly.

Five Cableways 3,100 Ft. Between Masts For Nile River Dam Work

FIVE aerial cableways, 3,100 ft. between masts, and the masts themselves 182 ft. high, are to be used for transportation of men and materials during the building of the Nag Hammadi Barrage, which is being constructed across the Nile River by Sir John Jackson, Ltd. The cableways are being designed and produced by John M. Henderson & Co., Ltd., of Aberdeen, and it is believed that they are the longest-span cableways ever constructed. The masts are being so arranged that they may be luffed sideways so that the main cable of each unit may be moved a distance of 25 ft. on each side of its center line to allow the plant to cover the required area. The load which each cableway can sustain will be 5⅗ tons at a hoisting speed of 250 f.p.m. and a traveling speed of 1,250 f.p.m. The total length of the steel wire rope required for cableways amounts to 22½ miles.

The equipment is operated by electrically-driven winding gears, the operating platforms being carried on towers about 400 ft. high to enable the drivers to obtain a better view of the operations. On each driver's platform there is to be a mechanically-operated indicator gear which will show the operator the position of the load at any time. Three of the five cableways have already been shipped to Egypt.

The information contained in this article is supplied by A. C. Blackall, 7 Vincent-Square Mansions, London, S.WI., England.

Welded Bulldozing Jack Made at Small Expense

By Harry Gonzer
Welding Foreman, The Lincoln Electric Co., Cleveland, Ohio

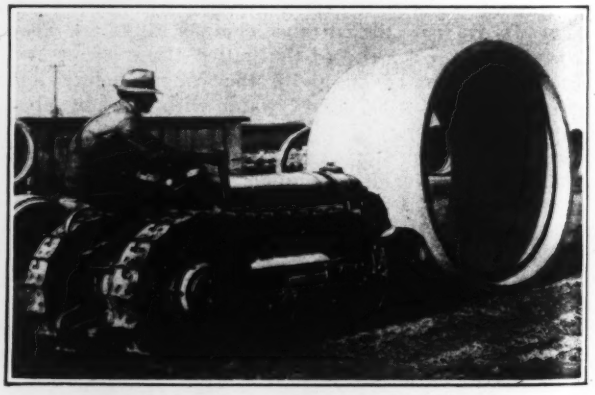
FOR straightening heavy structural shapes, a welded bulldozing jack was recently made for use in the welding department of the Lincoln Electric Co., at Cleveland. The jack was made at a small expense and will take the bow out of very large I-beams, channels or angles. The jack shown herewith is made entirely of standard mild steel flats. The thread bar is an ordinary 1 ft. 4-in. cap screw working through two nuts welded in line.

WELDED BULLDOZING JACK STRAIGHTENING I-BEAMS

Jigs and fixtures, such as this bulldozer, can be made in more or less indefinite numbers, utilizing scrap and some ingenuity.

Concrete Pipe Moved by Tractor with Roller Attachment

THE accompanying illustration shows a flexible roller attached to the front end of a crawler tractor, enabling it to roll pipe and tile when storing or shipping it. The Wisconsin Concrete Pipe & Tile Co., Beloit, Wisconsin, which company devised the roller, states that this method of moving the pipe is much less costly than by handling it in any other way. In the illustration a 7,500-lb. tile is being moved. This information was supplied by the Belle City Manufacturing Co., Racine, Wis., on whose tractor the roller has been attached.



CRAWLER TRACTOR ROLLING CONCRETE PIPE

From Job and Office

Hints That Cut Cost and Time

From Job and Office

For Contractor and Engineer

New Feature of Lewis Travelling Girder Speeds Tunnel Driving

THE LEWIS girder, as used in driving the Moffat tunnel, is employed in the heading and bench method of driving in soft ground and consists primarily of two parallel, 46-in. plate girders, 65 ft. long and 6 ft. apart. The device is mounted on the bench with 10 to 30 ft. of one end projecting beyond the bench face. This projection affords a temporary support for arch timbers and greatly facilitates mucking by making it unnecessary to set plumb posts close to the face. (See *Engineering News-Record*, June 11, 1925, p. 970.)

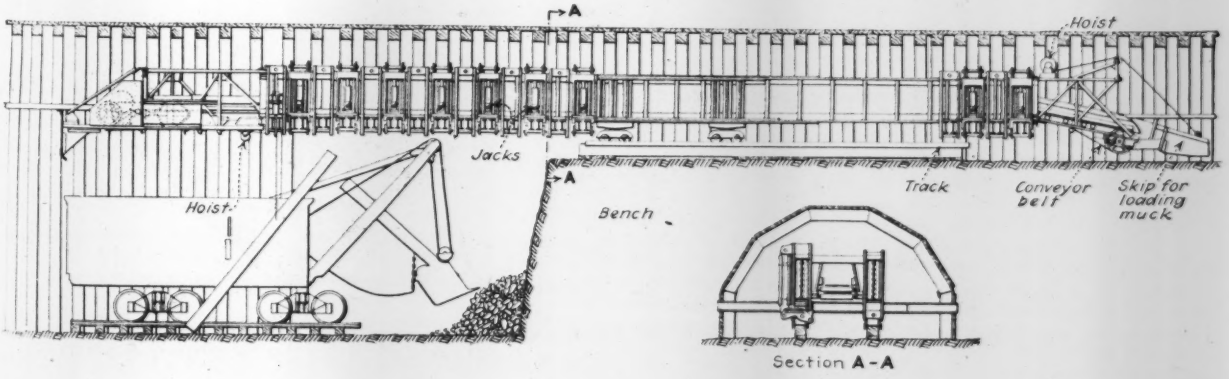
Recently a material improvement in the design of the Lewis girder has been effected whereby in addition to performing the function just mentioned it also moves muck from the bench to cars on the tunnel floor and delivers timbers and other materials to the bench for the heading and top widening operations. This is accomplished by a motor-driven belt conveyor between the two girders that constitute the main frame, supplemented by arrangements for delivery to and from the belt.

To put in the conveyor belt it was necessary to rearrange the cross bracing used in earlier types of the girder. In the new design the bracing carries the rolls for the belt but does not project into the clear space above the belt. A 30-in. belt is used and a 24-in. clearance above it is provided.

The belt is operated by a 50-hp. reversible motor at the discharge end and an electric controller is provided at either end. The normal operating speed is about 30 ft. per minute in either direction. Only one man is required to operate the belt and he takes up his position at the control box on either end, in accordance with the work being performed.

BELT CONVEYOR DISCHARGING TO MUCK CARS
When car is full, belt is stopped until empty is placed on loading track by air-hoist switch in foreground.

When the belt is delivering muck from the bench, muck cars coming back from the heading dump into a skip at the bench end of the belt. The skip is raised by an air hoist, also controlled by the operator, and thus delivers to the belt as required. On the discharge end of the belt delivery is sometimes into a timber bunker from which the muck is discharged as desired into cars on the tunnel floor while in other cases it has been found more convenient to deliver directly to the muck cars on the tunnel floor through a chute, as shown in the accompanying picture. As each car is loaded it is moved a short distance away from the bench, the belt being stopped while an empty car is placed by the air-hoist car switcher that picks up the empty from the siding and sets it down on the loading track. The conveyor belt feature of the Lewis girder is said to have very materially increased the girder's usefulness.



SECTION AND ELEVATION OF LEWIS GIRDER AS IMPROVED

George Lewis is general manager of the Moffat Tunnel Commission and inventor of the girder described in the foregoing. For the information in this article, *Engineering News-Record* is indebted to C. A. Betts, office engineer, Moffat Tunnel Commission.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Why Not Build Better Concrete Bridge Rails?

Sir—In driving over the country, the bridge engineer examines the guard rails of the bridges which he crosses, and this is what he sees. The majority of concrete bridges have thin rails, some plain, some more or less decorated or desecrated with panels, others being of the "spindly" type, that is to say having square or round spindles, balusters, openings of some sort through which the little children can look at the water. On second observation, the bridge engineer notices that a lot of these rails are going to pieces long before their allotted life. Some are lame, having lost a spindle or two in an encounter with a victorious truck. Others are cracked all over, showing wrinkles of premature old age. Still others are crumbling away at the joints. This not only is true of small bridges, but applies as well to structures worth six figures.

Then the engineer seeks the cause. Bridge rails must withstand more temperature variations than any other part of the structure. They are forever warm or cold, wet or dry. Being thin, some reinforcing bars are apt to be close to the surface, where they soon start to rust and explode the concrete. Any temperature or stress deflection in the arch or girder is often intensified in the rail above. The rails are subject at any time to the attacks of trucks and taxis on a rampage. But that is not all. The thin rail is not given a decent chance during its construction. The concrete is hard to place, and perhaps is too soupy. There are, of necessity, a large number of construction joints, horizontal or vertical, each joint a plane of weakness. It is no wonder then that so many concrete rails look sick.

Ninety-five per cent of the people never see anything of a bridge but the rail. They might occasionally read the names on the brass plate after looking at the rail. Fifty per cent of the people think that if the rail is falling down, the bridge is ready to collapse. The remedy seems simple. Why not build highway bridge guard rails heavier, more like the massive ones used frequently on ballasted-deck railroad bridges?

G. D. HOUTMAN.

Media, Pa.
Nov. 21, 1927.

Building Trades and Jurisdictional Disputes

Sir—On p. 815 of your issue of Nov. 17, 1927, appears a memorandum that the American Engineering Council has passed a resolution recommending that, if after reasonable time the building trades department of the American Federation of Labor does not modify its decision in regard to the National Board for Jurisdictional Awards, the board be abandoned. It is very unfortunate, of course, that the decisions of a board of this character cannot please everyone, but without some such tribunal to which jurisdictional disputes can be referred, the conditions in the building trades will become chaotic, as they were some years ago before the board started to function.

A recommendation that courts of law be abandoned because their decisions were not favorably received would be just as reasonable as the recommendation which has been made by the Engineering Council.

Perhaps a revision of the constitution of the national board should be made whereby the employer as well as the employee could apply for a decision in case of a jurisdiction dispute. But if we are to make agreements with union labor and attempt to keep strikes out of the building industry, it is absolutely essential that there be some court of last resort to which jurisdictional matters can be referred.

Instead of recommending that the national board be dissolved, it would seem that the council should insist that the board be continued, so that those having jurisdictional disputes may have some court to which to appeal for a decision. It would seem that the building public, which after all is the interest most vitally affected when strikes occur, has the right to demand that jurisdictional disputes be settled in the interest of economy and efficiency rather than in the interest of any particular union.

E. HAUPT,
President, Strobel Steel Construction Co.

Chicago, Ill.,
Nov. 25, 1927.

Acoustical Hotels

Sir—I wish to call to your attention the modern hotel in which I am writing at the present time, which is a prototype of many other hotels recently constructed. In these hotels, which are modern in every respect, the acoustics are so good that their only parallel is the Mormon Temple in Salt Lake City. A pin dropped after midnight sounds like the crack of a whip, and the turning of a water faucet like the downrush of waters when a dam breaks.

Some careful thinking, on the part of the architects who design these hotels, on sound as well as on stress would greatly add to the comfort of the traveling public.

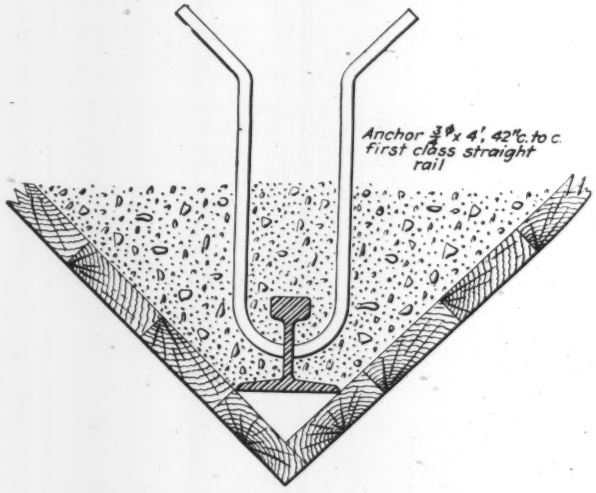
D.S.G.

Nov. 9, 1927.

Ice-Breaking Pier Noses

Sir—In your Sept. 29 issue, p. 522, there was a sketch of an ice-breaking pier nose submitted by John B. Karcher, Pittsburgh branch, Byllesby Engineering & Management Corporation.

In connection with this, I am attaching a sketch of the nosing rail which we have used successfully on our bridge piers for the last eighteen years. You will note that the rail is reversed in position and is placed so as to give a better bond to the concrete. The forms are built in the usual manner, and the base of the rail is placed against the formwork, thus making the installation quite easy. There is less danger of the concrete fracturing between the head of the rail and the face of the concrete as shown in my sketch than between the base of the rail and the face of concrete as shown by Mr. Karcher.



NOSING RAIL FOR BREAKING ICE AT BRIDGE PIERS AS USED BY GREAT WESTERN RAILROAD

W. R. ROOF,
Bridge Engineer, Chicago Great Western Railroad Co.

Chicago, Ill.,
Nov. 17, 1927.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Board of Estimate Authorizes Large N.Y. Sewage-Works

Activated Sludge Process For Parts of Manhattan and Bronx With Tunnels, Interceptors

A PROJECT for an 180-m.g.d. sewage-treatment plant on Wards Island to treat the sewage of parts of the boroughs of Manhattan and Brooklyn, New York City, together with intercepting sewers and tunnels, was approved by the Board of Estimate and Apportionment on Dec. 5. Authorization was also given for the employment of George W. Fuller, New York City, as consulting sanitary engineer on the project at $100 a day, with a total of not over $10,000 a year, and for a staff of engineers, under civil service, in two groups, one group for Manhattan and one for the Bronx, each headed by a designing engineer at $6,000 a year. The combined salary allowance, not including Mr. Fuller's fees, is $58,300 a year.

The project follows recomendations of an engineering committee, as follows: Arthur S. Tuttle, chief engineer of the Board of Estimate; C. M. Pinckney, chief engineer, Borough of Manhattan; Edward B. Wood, deputy chief engineer, the Bronx; and Clifford B. Moore, consulting engineer, Borough of Queens.

ACTIVATED SLUDGE METHOD PROPOSED

The activated-sludge method of sewage treatment is proposed, subject to final decision after further study. The estimated cost of sewage-works with a capacity of 180 m.g.d. is $16,000,000; of tunnels from Wards Island to Manhattan and to the Bronx, $1,200,000 and $2,000,000 respectively; and of interceptors, $7,300,000 in Manhattan and $2,000,000 in the Bronx. The areas to be served, for the present, are 2,519 acres in Manhattan and 4,134 in the Bronx, with populations estimated at 650,000 and 400,000 in 1927 and 700,000 each in 1960.

The 180-m.g.d. plant would take care of that part of the sewage of Manhattan now discharged into the East and Harlem Rivers between East 73rd and 155th Sts., Manhattan, now about 94-m.g.d., and into the same rivers from the Bronx between the West 133rd St. outlet on the Harlem and the East 138th St. outlet on the East River, now some 61 m.g.d. Five years is the estimated time for carrying out the present project.

Ultimately it is proposed to extend the Manhattan interceptor to W. 190th St., and the Bronx interceptor to take in all sewage now flowing into the Harlem River between W. 138th St., and New York University, as well as that now discharged into the East River at E. 149th St. A portion of Queens Borough may also be included at some future time. Full extensions, as proposed, cannot be made unless and until New York State cedes back to New York City the entire area of Wards Island, of which it granted only 52 of 234 acres in 1927, after 17 years of agitation.

President Coolidge Deals With Flood Control in Message to Congress

Mississippi River Problem Dismissed—Boulder Canyon Dam on Colorado Urged—Other Engineering Matters

PROBABLE revision of the allocation of cost of river improvement, restriction of federal participation to the lower river with consideration of tributaries only as they affect the main flood problem, and intimation that the survey to be embodied in a report which will be presented to Congress early in its session will emphasize a program calling for raising and strengthening of the levee system with provision for emergency spillways and improvements for the betterment of navigation, are the essential engineering features of that part of President Coolidge's message presented to Congress Tuesday which refers to the control of the Mississippi River.

Other matters in his speech relating to engineering include development of the Colorado River, general flood control legislation, highway construction and maintenance, railway consolidation, inland waterways, the Panama Canal and commercial aviation.

The President makes emphatic the fact that, although such floods as occurred last spring in the Mississippi Valley must be considered a national calamity the federal government's chief responsibility lies in the rebuilding of public works and the "humanitarian duty of relieving its citizens from distress." He asserts that the government "does not undertake to reimburse its citizens for loss and damage incurred" from the effects of flood and drought, heat and cold, earthquake and wind, lightning and tidal wave. He points out that under the present law whereby one-third only of the cost of the improvement is borne by land adjacent to the levees a "most extraordinary concession" is made from the plan adoption in relation to irrigation "where the general rule has been that the land benefited should bear the entire expense." His concluding remarks on this subject are:

It is true, of course, that the troublesome waters do not originate on the land to be reclaimed, but it is also true that such waters have a right of way through that section of the country and the land there is charged with that easement. It is the land of this region that is to be benefited. To say that it is unable to bear any expense of reclamation is the same thing as saying that it is not worth reclaiming. Because of expenses incurred and charges already held against this land, it seems probable that some revision will

Ouster Suit Against St. Paul Water-Works Engineer Upheld

That there is cause for action in an ouster suit against Clyde May, recently appointed general superintendent and engineer of the St. Paul water-works (see *Engineering News-Record,* Oct. 20, p. 651) was the decision reached by Judge Hugo O. Hanft in overruling a demurrer to the ouster action and holding that the complaint constitutes allegations sufficient for trial. The plaintiffs in the suit allege that Mr. May was not appointed in conformity with civil service rules of the city charter, the rules being illegally suspended in his case. The appointment was made on Aug. 4. The principal contention of the defendants was that the complaint did not state sufficient facts to constitute a cause of action. The court held that "the orderly administration of the civil service system is on trial in this action."

Flooded State Authorizes Reconstruction Fund

At a special session of the New Hampshire Legislature held last week the recommendation of the governor for financing reconstruction of roads and bridges damaged by the early November flood was adopted. This recommendation increases the gasoline tax from 3 to 4 cents a gallon, effective Jan. 1, 1928. A $3,000,000 bond issue was authorized which will be refunded from the proceeds of the gasoline tax over a period of years.

have to be made concerning the proportion of cost which it should bear. But it is extremely important that it should pay enough so that those requesting improvements will be charged with some responsibility for their cost, and the neighborhood where works are constructed have a pecuniary interest in preventing waste and extravagance and securing a wise and economical expenditure of public funds.

As to the general problem of flood control President Coolidge says:

A definite federal program relating to our waterways was proposed when the last Congress authorized a comprehensive survey of all the important streams in the country in order to provide for their improvement, including flood control, navigation, power and irrigation. Other legislation should wait, pending a report on this survey. The recognized needs of the Mississippi should not be made a vehicle for carrying other projects. All proposals for development should stand on their own merits. Any other method would result in ill-advised conclusions, great waste of money, and instead of promoting would delay the orderly and certain utilization of our water resources.

As to the recent flood damage done in New England President Coolidge asserts that "it may be necessary to grant special aid" for purposes of rehabilitation, although "a considerable sum of money will be available through the regular channels in the Department of Agriculture for reconstruction of highways." It is expected complete reports of what is required will be available early in this session of Congress.

Inland Waterways—Both the Board of Engineers of the War Department and the Joint Board of Engineers, representing Canada and the United States, the President states, believe that the St. Lawrence project is less costly and more feasible than the All-American canal and that the State Department has requested the Canadian government to negotiate treaties to provide for this improvement. "It will also be necessary" he concludes "to secure an agreement with Canada to prevent fluctuation in the levels of the Great Lakes."

Referring to the operation of the Inland Waterways Corporation the President asserts that "it is proving successful and especially beneficial to agriculture." Opening of public waterways has long been a federal function, he asserts, but emphasis is put on the fact that "the problems of transportation over inland waterways shall be taken up as private enterprise, so that the public will have the advantage of competition in service. It is expected some of our lines (demonstration barge lines) can be sold, some more demonstration work done, and that with the completion of the Ohio project a policy of private operation can be fully developed."

Colorado River — President Coolidge finds "legislation desirable for the construction of a dam at Boulder Canyon on the Colorado River, primarily as a method of flood control and irrigation" with power development and water supply for Southern California as secondary considerations. Both flood control and

(Continued on p. 939)

Highway Research Board Holds Annual Meeting

REPORTS from seven standing committees and two special committees were presented to over 300 delegates assembled at the 1927 meeting of the Highway Research Board at Washington, D. C., on Dec. 1 and 2. For the most part the reports consisted of several sub-committee reports, as many as ten in one case, and were presented orally only. The brief summaries possible by oral presentation made the proceedings sketchy and hard to condense into much of technical value to be carried away from the meeting. Two reports were exceptions, that of the standing committee on highway traffic analysis and that of the special committee on low-cost improved roads investigations. These reports will be summarized in an early issue.

Pontoon Bridge at Burlington Destroyed Through Overload

A pontoon bridge serving as an emergency crossing of the Winooski River between Burlington, Vt., and Winooski, Vt., and a structure which replaced a steel span carried out by the disastrous flood of early November, was destroyed through the submergence of one of the boats by an overloaded truck on Dec. 1. The bridge is shown herewith. At the time it was destroyed the river was at its highest stage since the record flood of early November. Reports from the Weather Bureau at Burlington are to the effect that during November 10 in. of rain fell, more than

WINOOSKI RIVER PONTOON BRIDGE

in any other month since the station was established.

As an indication of traffic which this pontoon bridge carried and which now will have to be detoured for several miles, the following traffic count made by First Lieut. L. R. Groves, Corps of Engineers, U. S. Army, and in charge of the engineers unit which installed the pontoon bridge, is offered.

TRAFFIC CHECK ON PONTOON BRIDGE AT BURLINGTON, VT.

Date	Passenger Cars	Trucks	Pedestrians	Weather
3:00 a.m. Nov. 18 to 3:00 a.m. Nov. 19, 1927	2,444	624	4,067	42
3:00 a.m. Nov. 22 to 3:00 a.m. Nov. 23, 1927	2,164	613	3,368	51
3:00 a.m. Nov. 27 to 3:00 a.m. Nov. 28, 1927	3,214	181	3,859	18

The character of the stream bed did not allow the use of drag anchors and boats were anchored to a steel cable spanning the Winooski River. However, the principal resistance to current was offered by the decided camber which it is seen the bridge had.

Portland Cement Association Holds 25th Meeting

Four hundred twenty-five persons representing 72 manufacturers attended the twenty-fifth anniversary meeting of the Portland Cement Association at the Blackstone Hotel, Chicago, Nov. 14-16. The sessions opened Monday morning with a meeting of the Board of Directors and committees on fire insurance, conservation, transportation, accident prevention and insurance, accounting, advertising, technical problems, papers for mill sessions, and packages.

At the general session Tuesday reports of the various committees were presented. M. A. Hyde, general engineer of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. read a paper on "Factors in the Choice of Waste Heat or Public Utility Power for Cement Plants." In a symposium on raw mix control, papers were read by E. Posselt, vice-president in charge of operation of the International Cement Corporation, New York City; Roy N. Young, assistant chemical engineer, Lehigh Portland Cement Company, Allentown, Pa.; and R. E. Roscoe, supervising chemist of the Phoenix Portland Cement Corporation at Birmingham, Ala.

At the opening of the business session Wednesday, memorial services were held for Nicholas W. Duncan, late chairman of the board of the Marquette Cement Manufacturing Company, whose memorial was read by G. S. Brown, and Richard Hardy, late chairman of the board of the Pennsylvania-Dixie Cement Corporation, whose memorial was read by L. T. Sunderland.

The business session closed with election of new officers and directors, which are as follows:

G. S. Brown, president and chairman; E. M. Young, first vice-president; Robert B. Henderson, second vice-president; and John L. Senior, treasurer.

The principal speaker at the banquet Wednesday evening at the Blackstone Hotel was Colonel George T. Buckingham.

One Panel of Steel Garage Being Erected in Chicago Fails in Violent Wind

A partly erected steel frame for a three-story garage building at Prairie Ave. and 24th St., Chicago, collapsed on Nov. 14, during a sudden and severe wind. One panel width of 18½ ft. had been erected for the two upper floors and roof for the entire length of the building, 166 ft. The erection was completed at noon on Saturday, Nov. 12, the material being all service bolted, but with all bolts tight and all exterior splices full or 100 per cent bolted, according to the contractor. Riveting could not be started until the framing was adjusted and plumbed.

On Monday morning the structure was being plumbed ready to start the riveting, but work was stopped by a heavy storm of rain and wind. During a violent gust of wind in the afternoon, the framing collapsed, falling forward; parts of the steelwork of the 18½ ft. front were thrown into the street and crushed a passing automobile. About twelve persons were injured, two in the automobile and most of the others sheltering from the rain in the contractor's shanty on the sidewalk. Part of the framing was of heavy construction on account of the open space for the garage on the first floor.

As the second floor was carried by plate girders, said to be about 55 ft. long and 40 in. deep, there was a large area exposed to wind pressure, with only the anchor bolts in the columns to resist this pressure. No diagonal bracing had been placed to stiffen the frame. Men on the work are said to have remarked that the framing rocked before it fell eastward into Prairie Ave., indicating that the anchor bolts restrained the original wind load until the wind caught it at the critical part of its vibration. The anchor bolts were either broken or had the threads stripped, while some of the footings (at first floor level) are said to have yielded, the concrete being rather green.

Geo. S. Klewer was architect; the Kelly-Atkinson Co., general contractor, and the Oscar Daniels Co. contractor for steel erection.

C. A. Crane, Long with New York Contractors Association, Dies

Clarence A. Crane, secretary and general manager of the General Contractors' Association of New York, and who had served this organization since 1909, died at his home in New York Dec. 5 after an illness of less than a week at the age of 53 years.

Born in New York Oct. 18, 1875, Mr. Crane was a student at both Columbia and Lehigh universities. He began his professional career with the New York, Susquehanna and Western Railroad in 1894, and after a few months, joined the Department of Parks in New York City as assistant engineer. In January 1891 he was employed by the Aqueduct Commission on construction of the Jerome Park reservoir, leaving that commission in 1903 to enter private practice.

Upon the organization of the General Contractors Association of New York City, Mr. Crane became the secretary and general manager. During his long association with the contractors he was particularly active in legislative affairs which concerned them, and the organization he built up was an exceptionally strong one.

Mr. Crane was elected a member of the American Society of Civil Engineers March 5, 1902.

Owens Valley Water Controversy Has Echo in Jail Sentence

W. W. Watterson and Mark Q. Watterson, owners of banks in Owens Valley, on Nov. 14 were each sentenced to terms of one to ten years in the state prison on the charge of embezzlement and falsification of bank records. Although each was found guilty on 35 counts and was sentenced to serve an indeterminate term of from one to ten years on each count, the court permitted the sentences to run concurrently. No request for probation was made and the prisoners started for the penitentiary the same day sentence was pronounced. The bankers blamed the failure of the banks on the tactics of the city of Los Angeles in its acquisition of Owens Valley water rights.

SOME OF COLUMNS OF DAMAGED GARAGE BEING REMOVED

Transit Commission Urges 42 Crossing Eliminations For N. Y. Area in 1928

The grade-crossing elimination program of the N. Y. Transit Commission (Metropolitan Division of the Department of Public Service) for 1928 calls for the elimination of 42 crossings of the Long Island Railroad and the New York Central Railroad at an estimated cost of $10,780,000 and for the further expenditure of $1,434,000 for ten additional propects made necessary to complete elimination already ordered.

There are seven projects embraced in the 42 crossing elimination projects proposed for 1928 made up as follows:

	Crossings	Estimated Cost
1. Corona elimination, L. I. R. R.	4	$1,000,000
2. Springfield elim., L. I. R. R.	6	1,400,000
3. St. Albans elim., L. I. R. R.	2	600,000
4. Rockaway Park to Arverne, L. I. R. R.	27	7,000,000
5. West 79th St. N. Y. Central	1	250,000
6. West 96th St., N. Y. Central	1	350,000
7. West 158th St., N. Y. Central	1	280,000
Total		$10,780,000

The elimination recommended to complete elimination programs ordered in the years 1926 and 1927 are:

Case	Cost
2794—Bridge St. Flushing, L. I. R. R.	$51,000
2830—Ozone Park elim., L. I. R. R.	267,000
2837—Auburndale–Bayside elim., L. I. R. R.	91,500
2795—Ft. Wadsworth elim., S. I. R. T. Ry. / 2797—Bay St. elim., S. I. R. T. Ry. / 2812—Tompkins Ave. elim., S. I. R. T. Ry.	75,000
2703—Manhattanville & Dyckman St., N. Y. C. R. R.: West 79th St. / West 96th St. / West 158th St.	92,500
Total	$1,434,000

In the Borough of Richmond the elimination of 21 grade crossings, known as the Port Richmond-Mariners Harbor group, is the subject of hearings now pending before the commission. Since it is estimated that this project requires two years to complete at a cost of $4,000,000 no other grade crossing elimination is suggested for the Borough of Richmond during 1928.

Elevation of M.C.R.R. at Gary To Cost Million

Preliminary plans for the elevation of the Michigan Central R.R. through Gary, Ind., a distance of about two miles, have been agreed upon by J. F. Deimling, chief engineer of the railroad, and W. P. Cottingham, city engineer. A resolution in favor of the work has been adopted by the board of public works, and a public hearing has been set for Nov. 24. Under the present plans there will be subway for six streets; at Broadway there will be a 31-ft. span for the roadway, with 15-ft. headroom, and separate spans for the sidewalks. The other streets will have single spans of 36 to 40 ft., with 14-ft. headroom. Work will be started soon after the signing of the proposed contract, and is to be completed within two years. The total cost, including street paving and sewer changes, is estimated at $1,004,300.

Building Contractors Decry Unions' Withdrawal from Jurisdictional Award Body

At a meeting of building contractors held in Chicago on Nov. 29, the labor and wage conditions and building prospects in several cities were presented and discussed. The most important business was consideration of the action of the building trades department of the American Federation of Labor in withdrawing from the National Board of Jurisdictional Awards in the building industry. This subject was discussed by the contractors present and by representatives of the American Institute of Architects, the National Association of Building Trades Employers and the Associated General Contractors of America. Conclusions arrived were substantially as follows:

The building trades department of the American Federation of Labor has taken a step backward by withdrawing from the present board before any suitable provision was made for solving the problem of jurisdictional disputes, which is the greatest menace to the building industry, to the building public and to labor. This board has an obligation to the public and to the industry that makes it imperative to continue, for the purpose of making its past decisions available and until an acceptable substitute for it be created.

In order that work may continue without interruption, local associations and organizations should create conference boards in their respective communities and devise ways and means to settle their own jurisdictional disputes. The building trades department should be impressed with the fact that the building industry must have some representative national tribunal to deal with national jurisdictional problems, preferably with the co-operation of labor.

Heavy Rains Do Damage in Western New York

A number of counties in southwestern New York have been more or less inundated by a heavy rainfall which extended over a three-day period, Nov. 29 - Dec. 1. In the Genesee Valley bridges have been swept away and highways flooded, with damage estimated at several hundred thousand dollars. It is reported that the spillway of the Mt. Morris dam near Albany was under 11 ft. of water and that at Geneva a landslide across the railroad tracks tied up the Pennsylvania trains temporarily. The Weather Bureau at Jamestown, in the center of the inundated portion of Chautauqua County, reported a total November rainfall of 10.07 in. as compared with an average monthly rainfall of 3.398 in. for the last six years.

A number of Pennsylvania towns in the western part of the state were also affected by the high water. It is reported that the total precipitation for November was more than 12 in. in Bradford, Pa.

Asphalt Paving Conference Held At Atlanta, Ga.

Large Attendance of City Engineers, Highway Officials and Asphalt Chemists

(Engineering News-Record Staff Report)

ABOUT 350 representatives of the asphalt industry, paving engineers and contractors and asphalt technologists attended the sixth annual asphalt paving conference held at Atlanta, Ga., during the week of Nov. 28-Dec. 3. The conference as usual was under the auspices of the Asphalt Association and this year the Association of Asphalt Paving Technologists conducted its proceedings as a part of the general conference. A notable feature was the large attendance of city engineers of paving, state highway officials, paving contractors and asphalt chemists. The program too was made up entirely of technical papers. These were divided broadly into two groups: (1) papers on asphalt technology and (2) papers on asphalt pavement design and construction.

Technological Papers

The program of the asphalt technologists took up the larger part of three sessions. Nine outstanding papers were presented: Variation in asphalt film thickness on mineral aggregate in relation to design and control of paving mixtures by A. R. Ebberts, engineer of tests, Allegheny County, Pennsylvania, was an extension of an article published in *Engineering News-Record*, Sept. 23, 1926, p. 513. It described experiments directed toward working out a chart for determining bitumen in coarse asphaltic cements. The chart arrived at is given in the article above referred to. Variations in absorption of asphalt by different mineral aggregates by A. W. Dow, chemical engineer, New York City, was a highly technical consideration of the effects of colloidal films on absorption. Factors affecting the stability of asphalt paving mixtures by Frances P. Smith, chemical engineer, New York City, was a notably practical discussion of asphaltic cement, filler and mineral aggregate requirements for stability with particular mention of the fact that stability is also a factor of the kind and character of foundation, the uniformity of the mixture, the perfection of workmanship and the amount of compression.

Prévost Hubbard and F. C. Field, chemical engineer and chemist of the Asphalt Association, presented a continuation of their several years work on the evaluation of sands for sheet asphalt pavement. The paper was long, with many graphs and tables. In general the conclusion was that when evaluating a paving mixture by means of this stability test *(Engineering News-Record*, Nov. 27, 1924, p. 862), the percentage of voids in the total compressed mixture should be given consideration and, other things being equal, preference should be given to that mixture which carries the highest percentage of asphalt and shows the lowest percentage of voids when thoroughly compressed. By so doing, greater insurance will be obtained against weathering disintegration and cracking. In a supplementary paper Mr. Field described a commercial machine for making the characteristic Hubbard-Field stability test and told of its practical use on several paving operations.

Other papers were "Research Data Confirming Voidage and Shear Strength Design of Sheet Asphalt Paving Mixtures," by H. W. Skidmore, Chicago Paving Laboratory; "Recent Researches in Portland Cement Concrete and Their Application to the Design of Bases for Asphalt Pavements" by Roy M. Green, Western Laboratories, Lincoln, Neb., and "Effect of Special, Unusual or Non-Essential Tests in Asphalt Specifications" by Julius Adler, consulting engineer, Philadelphia, Pa.

Paving Papers

Leading papers in the paving engineering field were read by Thomas H. Mac Donald, C. N. Conner, E. N. Seymour and V. L. Ostrander; abstracts of all four are published elsewhere in this issue. Other papers were: "Compressing and Controlling Uniformity of Contour of Asphalt Pavements," by R. D. Kneale, Sam Finley, Inc., Atlanta, Ga.; "Relative Advantages of Smooth and Rough Texture Asphalt Surfaces," by A. H. Blanchard, consulting engineer, Toledo, Ohio; and "Maintenance Requirements and Service Records and What They Have Developed," by Geo. D. Fisk, assistant engineer, department of public works, Buffalo, N. Y.

Grade Crossings Designated for 1928 Elimination Total $30,867,700 for New York

The Public Service Commission of New York has designated 174 projects involving 203 grade crossings of railroads in 51 counties of the state outside of Greater New York, which will be considered for elimination during 1928. The estimated cost of these projects is $30,867,700 to be paid under existing laws, one-half by the railroad corporations and one-quarter each by the state and the municipalities wherein the grade crossings are located. The state will pay its share out of the $300,000,000 to be provided by bond issues under the constitutional amendment passed at the recent election. The railroads and municipalities, if they so elect, may borrow from this state fund to pay their share of the elimination work. Hearings by the commission on 174 projects will follow shortly.

Erie county leads the list with 37 suggested eliminations, 24 of which are in Buffalo, and the total cost for which will be $8,371,000.

President Deals With Flood Control in Message

(*Continued from p. 936*)

water supply are governmental considerations but "every other possibility should be exhausted before the federal government becomes engaged in the power business." He decries the inability of the states concerned in development of the Colorado to reach an agreement and if they (the states) wish the federal government to undertake Colorado River development they "should not hesitate to make the necessary concessions to each other." The Columbia River Basin project is dismissed with the statement that it will be considered at some future time.

Highways — Federal participation in highway construction President Coolidge asserts should be restricted to trunk-line systems, the national tax on automobiles ("on low priced cars not more than $2 or $3 each year") being now nearly sufficient to pay this cost. He asserts that inasmuch as good roads are no longer a program confined to the United States, this country should, by authority of law, provide "engineering advisers for the construction of roads and bridges" to other countries requesting such assistance. Precedent of a sort is found in the practice of supplying these countries with military and naval advisers.

Miscellaneous—it is set forth in his message that "in order to increase the efficiency of transportation and decrease the cost to the shipper, railroad consolidation must be secured" and that legislation is necessary to facilitate such consolidation, "always under the control and with the approval of the Interstate Commerce Commission."

The policy already adopted by Congress, the President asserts, is producing the "sound development" of commercial aviation, which is receiving at the present time great impetus. Already almost 8,000 miles of airways are completed and about 4,000 more miles contemplated, of which 4,400 miles are equipped and over 3,000 miles more will have lighting and emergency landing fields by next July.

Proposed Steel Arch Over Kill van Kull Is Subject of War Department Hearing

Permission to erect a bridge over the Kill van Kull from Bayonne, N. J., to Port Richmond, Staten Island, was asked by the Port of New York Authority at a hearing Nov. 30 before the War Department. There were two protests, both raising the question whether a tunnel would not be more satisfactory than a bridge. On the other hand, the Staten Island Deeper Waterways Association, representing manufacturers, shippers and oil interests along Arthur Kill and Kill van Kull, reported in favor of the bridge. Towing contractors and tugboat owners, some of whom had originally opposed the Arthur Kill bridges, now under construction, reported as favoring the proposed Kill van Kull crossing.

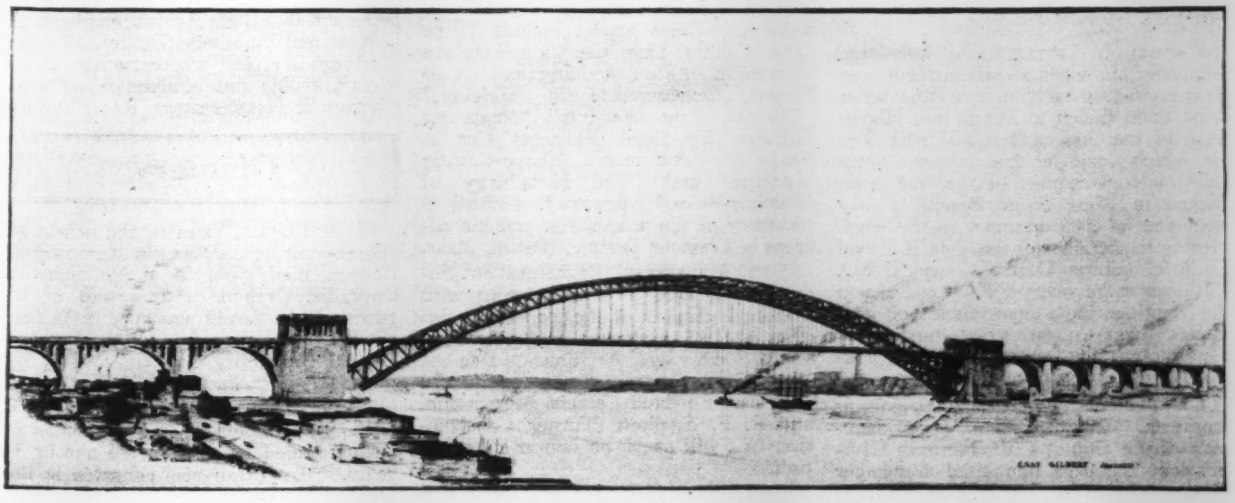
Kill van Kull is the main gateway to Newark Bay and Arthur Kill and carries annually an immense volume of shipping. This has made necessary a structure with especially large clearances, and an arch bridge with an opening of 1,640 ft. between abutments and a maximum clearance at the center of the span of 150 ft. above mean high water has been planned. Although the proposed structure is about 60 per cent longer than the longest existing arch span, an arch of almost the same span is now in course of construction at Sydney, Australia.

In his preliminary progress report, O. H. Ammann, chief bridge engineer, Port of New York Authority, gives some of the details of the bridge. "It has been decided," says the report, "to recommend that the bridge be designed so that it may be opened for a four-lane vehicular roadway, but that it be made wide enough so that at least three additional roadways may be added, or in their place, two rapid-transit tracks." The bridge is to have a single deck. Footwalks for pedestrians will also be provided. The bridge will have a total length from plaza to plaza of 6,380 ft. and will cost about $16,000,000. Construction work will start immediately after approval of plans by the War Department and the selling of a preliminary bond issue of $12,000,000. The report states that "If funds for the construction of a bridge should become available on or about Jan. 1, 1928, it will be possible to commence construction work in the summer of 1928 and to complete the bridge ready for initial traffic by 1932."

Philadelphia Engineers Club to Hold Fiftieth Anniversary

The fiftieth anniversary of the Engineers Club of Philadelphia will be celebrated Dec. 16 and 17. The general subject will be "Engineering Progress and World Civilization," with the speakers at the evening session, Dec. 16 John R. Freeman, past-president, American Society of Civil Engineers, and Ambrose Swasey, past president, American Society of Mechanical Engineers, whose topic will be "The Past in Engineering."

Saturday morning at 11:30 o'clock, a special convocation will be held at the University of Pennsylvania, at which time honorary degrees will be conferred by the university upon three guests of the Engineers Club. "The Present in Engineering" will be discussed at the afternoon session by William C. L. Eglin, president of the Franklin Institute, Howard Elliott, chairman of the board, Northern Pacific Railway, and Charles M. Schwab, honorary member of the Engineers Club and president of the American Iron & Steel Institute. "The Future in Engineering" will be discussed at the evening session, and the speakers will be Samuel Rea, honorary member of the Engineers Club and past president of the Pennsylvania Railroad, Dexter S. Kimball, president of the American Engineering Council and dean of the college of civil engineering of Cornell, and John Hays Hammond.



ARCHITECT'S DRAWING OF PROPOSED KILL VAN KULL INTERSTATE BRIDGE

Personal Notes

CHARLES E. SMITH, consulting engineer for the city of St. Louis, who last fall completed a transit survey of New York City for the city controller, has been named a vice-president of the New York, New Haven & Hartford Railroad. Mr. Smith will assist President Edward J. Pearson in problems relating to improvements, construction, operation and other matters. It is understood his immediate responsibility will relate to the development of plans for meeting increasing traffic requirements and for better service to shippers and passengers. Mr. Smith has been consulting engineer for St. Louis for the past 12 years. He went to St. Louis twenty years ago, being at that time with the U. S. Geological Survey. In August 1907 he joined the engineering staff of the Missouri Pacific Railroad. During the World War he was a major in the Construction Division.

FRANK LEE, who was engineer of maintenance-of-way, Western Lines, Canadian Pacific Ry., Winnipeg, Man., has been appointed district engineer, British Columbia District, vice F. W. ALEXANDER, appointed engineer, maintenance-of-way, Western Lines.

JOHN A. ELY has been appointed, for the present school year, assistant professor of engineering at the University of Hawaii, at Honolulu. He is on a year's leave of absence from St. John's University, Shanghai, China, which is closed until September, 1928. Mr. Ely had been connected with St. John's University since 1912, recently as dean of the College of Arts and Sciences and head of the Department of Engineering. He took engineering work at Princeton University and previous to 1912 had been in structural steel work in New York City.

EDWARD M. COOKE, vice-president of the Ludlum Engineering Corporation, New York City, has just returned from Central America where he inspected the property of the Guatemala Gold Dredging Co.

EDWARD I. LITTLE, who last June completed his work as resident engineer of construction of the extension from West Palm Beach to Miami and Homestead of the Seaboard All-Florida Ry., for which road he had worked since 1924 on construction of the line from Tampa to West Palm Beach, is now employed as civil engineer in the engineering department of the Tela Railroad Co. in Honduras, Central America. Mr. Little spent the years 1920-24 in Cuba in the engineering department of the United Fruit Co. on varied engineering construction but chiefly railroad, railroad bridges, and shop foundations.

DWIGHT E. WOODBRIDGE, consulting engineer. Duluth, Minn., also chairman of the Duluth City Planning Commission, has been appointed a member of the Minnesota Port Commission, to succeed William H. Hoyt, whose death was noted in these columns Nov. 17.

Engineering Societies

Calendar

Annual Meetings

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Detroit, Mich., Jan. 9-10, 1928.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 18-20, 1928.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 23-27, 1928.

NATIONAL ASSOCIATION OF BUILDERS' EXCHANGES, Washington, D. C.; Annual meeting, Miami, Fla., Feb. 6-9, 1928.

THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS held meetings in Chicago of its power and machinery division on Nov. 29 and 30, and its structures division on Dec. 1 and 2. The program included the following papers: "Developments in Farm Machinery," H. B. Walker, U. S. Department of Agriculture; "Mole Drainage," O. E. Robey, Michigan State College; "Developments in Tillage Machinery," F. A. Wirt, J. I. Case Threshing Machine Co.; "Recent Changes in Tractors," L. E. Wallace, University of Nebraska. Design of farm houses and general farm buildings was the subject of several papers in the structures division, supplemented by a paper on "Cutting Labor Costs by Efficient Planning of Farm Buildings," by Peter Grubb, farmer, Ohio.

THE NEW ENGLAND WATER WORKS ASSOCIATION in co-operation with the Affiliated Technical Societies of Boston, will have a meeting Dec. 14 for the consideration of a number of papers on welding. These papers include "Pipe Line Welding from the Oxy-Acetylene Viewpoint," "Pipe Welding and Other Recent Developments in Welding," "Thermit Pipe Welding," "Replacing Castings By Steel Elements Cut to Shape by Automatic Shape-Cutting Machine" and "The Metallurgy of Welding-Wire." Frank J. Gifford is secretary of the association and his address is Tremont Temple, Boston, Mass.

THE ROCHESTER ENGINEERING SOCIETY will hold a joint meeting with the local chapter of the American Society of Civil Engineers and the Rochester Society of Architects, Dec. 9. Wm. F. Lockhardt, district structural engineer, Portland Cement Association, and R. F. Egelhoff, Turner Construction Co., will speak on winter construction.

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA on Nov. 15 had an illustrated lecture on "The Construction of the Muscle Shoals Dam" by Capt H. C. Whitehurst, Corps of Engineers, assistant engineer commissioner of the District of Columbia.

THE PROVIDENCE, R. I., ENGINEERING SOCIETY on Nov. 15 had an address, "View of the English Engineering Industry," by John R. Ratcliff, a representative of the flor-meter department of the Kent Instrument Works, London, England, and while in this country connected with the Builders Iron Foundry.

THE AMERICAN WATER WORKS ASSOCIATION announces state section meetings as follows:

Kentucky-Tennessee Section—Louisville, Ky., Jan. 19-21, 1928; F. C. Dugan, State Board of Health, Louisville, secretary.

Rocky Mountain Section — Denver, Colo., Feb. 23-24, 1928, and Pueblo, Colo., Feb. 25; Dana E. Kepner, Colorado State Board of Health, Denver, secretary.

Montana Section—Lewiston, March 8-10, 1928; H. B. Foote, director, Division of Water and Sewage, State Board of Health, Helena, secretary.

THE ENGINEERS' SOCIETY OF MILWAUKEE at its annual meeting elected Alex. H. Luedicke, president; Fred Doepke, vice-president, and Robert Cramer, secretary.

THE ENGINEERS' CLUB OF CINCINNATI had at its November meeting a paper on "Electric Arc Welding of Structural Steel" by A. G. Bissell, of the Westinghouse Electric & Manufacturing Co.

THE AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION has selected the following subjects for committee reports at the 1928 meeting: (1) "Jacking and other methods of putting pipe culverts in existing fills; (2) making and placing precast concrete units; (3) emergency bridge and water-service work; (4) wrecking railway buildings; (5) painting buildings; (6) operation of water stations; (7) use of motor trucks for handling supplies. The president is H. C. Baluss, engineer of bridges and buildings, Duluth, Missabe Northern Ry. and the secretary, C. A. Lichty, bridge and building department, Chicago & Northwestern Ry., Chicago.

Obituary

G. A. COVELL, dean of the school of engineering of the Oregon Agricultural College, died Nov. 20 at his home in Corvallis, Oregon, at the age of 65 years. Dean Covell was born in Walesburg, N. Y., and was a graduate of Cornell University.

RICHARD G. OLSON, contracting engineer of Denver and the son of Arvid Olson, with whom he was associated in business, died Nov. 30 at the age of 33 years. Mr. Olson was educated in the Denver Manual Training School and at the University of Colorado.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Old Hoist and Derrick Companies Consolidate Sales Efforts

Two of the oldest manufacturers of hoists and derricks in the United States have consolidated their sales efforts in one sales company, the Mundy Sales Corporation, which will operate as distributor for the J. S. Mundy Hoisting Engine Co., Newark, N. J., and the Dobbie Foundry & Machine Co., Niagara Falls, N. Y. The Mundy Sales Corp. has its main office at 30 Church St., New York City.

The Mundy Hoisting Engine Co. was founded in 1869 and built hoists under patents taken out by J. S. Mundy in 1875 on a friction drum device. The Dobbie Foundry & Machine Co. was incorporated in New York state in the year 1892 and has been active since in the development and upbuilding of its derrick business. It is the successor to Archibald Dobbie of Thorold, Ontario, who established a business in contractors' equipment on the old Welland Canal in 1862. The latter Mr. Dobbie was the patentee of a single and double drum hoist used in the early construction of the Canadian Pacific and West Shore Railways. He also, it is stated, designed and built the original derricks for quarrying and laying stone in the Welland Canal locks and bridge abutments, and since then the Dobbie company has made a specialty in the design and development of the derrick line.

Acetylene Body Discusses Technical Problems

At the annual meeting of the International Acetylene Association, Nov. 16, 17 and 18, in Chicago, the technical sessions were outstanding. H. L. Whittemore, Bureau of Standards, Washington, D. C., outlined the testing work on welded specimens conducted by the Bureau of Standards, and described a series of tests on welded pressure vessels and welded structural steel which the Bureau will soon undertake.

The subject of the relative efficiency of city gas and acetylene as fuel gas for cutting with oxygen was discussed in two papers. J. K. Mabbs, Union Carbide Sales Co., New York, showed by a series of laboratory tests that the theoretical efficiency and the efficiency in practice for city gas as compared with acetylene was in favor of acetylene. A second paper, by J. L. Anderson, National Carbide Co., New York, presented the same views as did that of Mr. Mabbs. W. B. Miller, Union Carbide & Carbon Research Laboratories, Inc., Long Island City, N. Y., in a paper on the "Mechanical Testing of Welds," mentioned an important adaptation of the bend test for welded specimens in which the stretch in the outside fibers of the specimens is measured at the point where the first fracture appears (*Engineering News-Record*, Nov. 17, 1927, p. 800). T. W. Greene, New York, described a "Shear-Vee Joint for Bronze Welding Cast Iron Pipe," an account of which was published in *Engineering News-Record*, Dec. 1, 1927, p. 880.

The association's annual award for exceptionally meritorious service in the production and utilization of calcium carbide and acetylene, known as the Morehead Gold Medal, was presented to Dana Pierce, president Underwriters' Laboratories, Inc. L. E. Ogden, Oxweld Acetylene Co., New York, was elected president of the association for the year 1927-28.

Hearing Ordered by I. C. C. on Interstate Rates on Cement

The Interstate Commerce Commission, at a general session on Nov. 14, ordered that the commission should enter upon an "investigation into the reasonableness and lawfulness of the interstate rates on cement, in carloads, for all hauls of 80 miles and less included within the territory bounded by the following lines: The International boundary between the United States and Canada on the north, the Buffalo-Pittsburgh line, the Ohio River and the Mississippi River south of Cairo, Ill., on the east, the Ohio River, Gulf of Mexico and International boundary between the United States and Mexico on the south, and the western boundary of that portion of Texas, Colorado, Wyoming and Montana in which these rates now apply on the west."

It was further ordered that all the railroads subject to the Interstate Commerce Act be made respondents to this proceeding, and that it be assigned for hearing at such times and places as the commission may direct.

Business Notes

RICHARD DEVENS, for twenty years New York manager, Brown Hoisting Machinery Co., has joined the Link-Belt Co., Chicago, as sales engineer in the eastern territory with headquarters in New York City.

STERLING ELECTRIC MOTORS, INC., 124 West Fourth St., Los Angeles, Calif., has recently been organized by Carl E. Johnson, formerly vice-president of the U. S. Electrical Mfg. Co. The new company will manufacture a line of electric motors and motor specialties. A new factory will be in operation by January, it is reported. Associated with Mr. Johnson as officers of the new company are J. M. Sharp, Earl Mendenhall, Allen A. Adams, and Horace S. Walling, who were formerly president, chief engineer, superintendent and sales engineer, respectively, of the U. S. Electrical Mfg. Co.

RALPH R. SILVER, for the past 12 years advertising manager, American Cast Iron Pipe Co., is now associated with the Cox Advertising Agency, Birmingham, Ala., and under plans of re-organization will acquire a substantial interest in the firm. With Mr. Silver's addition to the firm, the agency, it is stated, will specialize in industrial advertising and publicity.

THE EASTERN PAVING BRICK MANUFACTURERS' ASSOCIATION will hold its annual meeting Dec. 13, at the Hotel Roosevelt, Pittsburgh. William C. Perkins, Lincoln Building, Philadelphia, is secretary.

GEORGE W. TORRENCE, manager, Chicago office, Pittsburgh Testing Laboratory, died suddenly November 16 at his home.

New Developments

A New Crawler Truck Powered by Fordson

A new crawler truck powered by a Fordson tractor has recently been introduced by the Law Mfg. Co., Inc., New York City. The crawler unit is of the

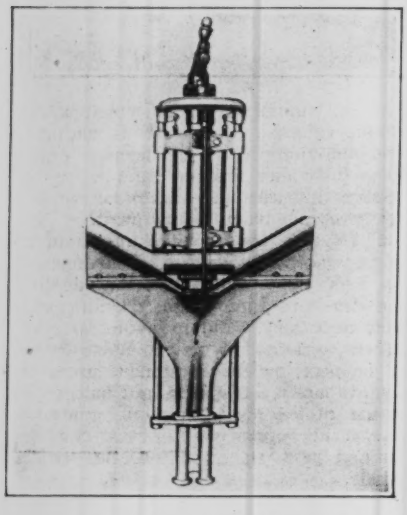
rigid self-supporting type, constructed without rollers. The track is claimed to be non-clogging in the deepest mud, and is full roller bearing equipped with pressure lubrication. Eccentric bushings provide track adjustment. The track tread is 14 in. wide, and is of a design which is claimed to permit operation over improved roads, but, at the same time, providing ample traction grip when necessary. Dump bodies of the rollover, gravity or power hoist types can be used on the equipment up to 3 cu.yd. capacity. It is also said that, with the use of the power take-off, concrete mixers, air compressors, etc., can be mounted and operated on the truck chassis.

Automatic Nailing Machines for Bridge and Warehouse Floors

Automatic nailing machines with one, two or three driving barrels have been developed by the Duplex Automatic Nailer Co. Inc., Logansport, Ind. The small three-barrel machine, shown in the upper illustration, weighs about 50 lb.

and will drive No. 4 to 10 penny nails at a capacity speed of 60 nails per minute. The larger duplex machine, illustrated below, drives from No. 20 to No. 60 spikes at a speed capacity of 20 per minute. The latter model is especially adapted to bridge and warehouse floor work, freight car construction, shipbuilding, and in fact, any spiking job where the driving is vertical. The duplex machine weighs 78 lb.

Nails to be driven are placed in the hopper from which slots lead to the driving barrels. An air hammer mounted in the two cross heads, is movable, upward and downward, on the guide rods by the operator, the weight being taken by the springs. Lifting the cross head assembly permits one nail to enter each driving barrel. The cross head assembly is then lowered until the nail-sets rest on the heads of the nails when air pressure is applied by the throttle valve. A No. 9-C Ingersoll-Rand hammer is used requiring a pressure of from 90 to 120 lb. The overall height of the nailer is 43 in. and the extreme width 21 in. The body is an aluminum casting, the guide rods are bronze lined, and hardened steel is used in the nail slots.



Centrifugal Unit Weighing 95 lb. Pumps 125 g.p.m.

A new portable centrifugal pumping unit weighing 95 lb. with a capacity of 125 g.p.m. is being placed on the market by the Homelite Corp., Port Chester, N. Y. The unit consists of a centrifugal pump with bronze open-type impeller direct connected to a 1½-hp. single-cylinder air-cooled engine operating on gasoline or kerosene. Both pump and engine are mounted on the same base which also acts as a fuel tank, holding one gallon, sufficient fuel to operate the engine for four or five hours. The single shaft runs on oversize Norma Hoffman ball bearings.

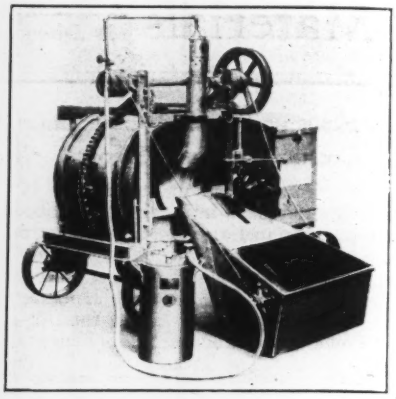
Pump suction and discharge are 2 in. in diameter. The lift of the pump is 20 ft. The engine, being air cooled, may be operated in the lowest temperatures. Ignition is supplied by a Bosch high tension damp proof magneto.

Portability is due not only to its low weight of 95 lb. but also to the fact that the unit can be set anywhere without need for foundations, skids or blocking. Spring feet results in stability and absorption of vibration.

Concrete Heater for Mixers of All Types and Sizes

A line of kerosene burning concrete heaters, suitable for mounting on any make or size of mixer, has recently been made available by Littleford Brothers, Cincinnati, Ohio. With such a heater, the manufacturers claim, a mix can be discharged in zero weather at a temperature of 75 deg. F. No additional labor is required since the man who operates the mixer also operates the heater.

The unit consists of a torch-type oil burner with fuel tank, oil hose, necessary fittings, and elbow flame deflector. A simple valve adjustment regulates the flame to any desired size. The windshield on the burner assures perfect operation under all weather conditions.



Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING. Sixth Annual Show. New York City, Dec. 5-10.

EASTERN PAVING BRICK MFGRS. ASSN., Philadelphia; Annual meeting, Pittsburgh, Dec. 13.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington, D. C.; Annual Convention, Detroit, Jan. 4-6, 1928.

ASSOCIATED EQUIPMENT DISTRIBUTORS, Milwaukee; Annual meeting, Cleveland, Jan. 6-7, 1928.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington, D. C.; Annual Convention, Cleveland, Ohio, Jan. 9-14, 1928.

NATIONAL CRUSHED STONE ASSOCIATION, Washington, D. C.; Annual Convention, West Baden, Ind., Jan. 16-19, 1928.

New Publications

Waterproofing Concrete — MINWAX COMPANY, INC., New York City, has published a folder discussing the function of waterproofing in connection with exposed concrete. The bulletin cites statements made by prominent engineers with regard to the necessity of concrete protection. It illustrates and describes the use of Minwax waterproofing and protecting products on several large and important structures.

Compressors—SULLIVAN MACHINERY Co., Chicago, Ill., has published a new 16 page bulletin No. 83-G, describing a new line of Sullivan high-pressure angle compound compressors suitable for pressures from 250 to 1,000 lb. per sq.in.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Cost Data On A Loft Building Completed In March, 1927

Located In Ohio—Value $155,000—Contents 486,000 Cu.ft. at 32c. per cu.ft.

A SCHEDULE of costs on a five story and basement loft building in Ohio, valued at $155,228, is given herewith. Cubic contents were 486,610 cu.ft. at a rate, including architect's fee, of 32c. per cu.ft.

Contracts for excavation, column footings, and basement walls were let May 12, 1926. Other building contracts let June 11, 1926. Building was completed March 1, 1927. Extras under the general work are for miscellaneous cabinets built in for the owners. Extras under the plumbing contract, for special water, gas, and acid proof drain lines installed for tenant on fifth floor. Extras in electrical contract, for a special line for tenant on fifth floor.

A brief description of the building, follows: Five stories and basement; outside dimensions, 110 ft., 8 in. wide, by 60 ft. deep, by 70 ft. high from basement floor to top of roof; building, five bays wide by three bays deep; construction of floors—two-way reinforced concrete slabs with drop panels, live load 300-lb. per sq.ft.; exterior walls—factory side wall, projected ventilator sash; concrete spandrels, except in the end walls where there are no windows and the spandrels are brick; concrete parapet walls and coping; reinforced concrete pent house and hand-ball court walls. Two stair ways; passenger elevator; and freight elevator to all floors. Two paper lifts between first and second floors. Stairs and stair and elevator shaft walls, reinforced concrete; partitions around toilet rooms occupying one interior bay on each floor, clay tile with cement plaster; entrance lobby in first floor with tile walls (sound proofed by Stevens System) cement plaster on factory side, ornamental plaster (imitation Travertine) on lobby side; rubber tile lobby floor, marble base; revolving entrance door; unit steel and glass interior office partitions, ceiling height, on second and third floors; all doors with metal jambs and trim; toilet room doors, wood; all other doors hollow metal, except freight elevator, counter-balanced kalemein doors; Conduo base set into concrete around all exterior walls; one line of conduit for power, and two lines for light carried longitudinally down center of each bay; four light outlets and two power outlets in each bay; all interior wall and ceiling surfaces above basement finished in egg-shell mill white paint; no plaster, except as hereinbefore mentioned; vapor steam heat; fan exhaust ventilation for toilet rooms.

There is an inclosed handball court on the roof with reinforced concrete walls and frame roof. The ceiling, plastered on metal lath. There is no plaster on the walls, and floor is maple on wooden sleepers. This connects with shower and locker room in passenger elevator pent house.

SCHEDULE OF COSTS

	Contract Amount	Extras	Per Cent of Total Contract (Extras not included)
General Work—			
Excavation and concrete foundaton	$9,650	....	6.6
Concrete	44,642	....	30.6
Brick and tile partitions	2,000	....	1.4
Lathing and plastering	4,164	....	2.9
Millwork and carpentry	5,867	$606	4.0
Miscellaneous and ornamental iron	2,434	....	1.7
Steel sash	4,522	....	3.1
Metal doors	6,559	....	4.5
Metal toilet partitions	725	....	0.5
Painting and glazing	5,785	112	4.0
Roofing	2,061	....	1.4
Marble work	418	....	0.3
Finish hardware	950	....	0.6
Metal office partitions	6,487	....	4.4
Other expense	6,500	....	4.5
	$102,764	$718	70.5
Plumbing, Heating and Ventilating—			
Soil pipe	$2,150	$395	
Sump pump	380	....	
Water pipe	1,950	401	6.4
Water heater	550	....	
Plumbing fixtures	4,064	....	
Gas fitting	260	47	
Boilers	1,800	....	
Steam piping	3,048	....	
Valves and traps	650	35	8.3
Radiators	2,953	....	
Ventilating equipment	1,116	....	
Heat regulation	2,603	....	
	$21,524	$878	14.7
Electrical Work—			
Conduit and fittings	$2,717	$213	....
Panels and cabinets	829	62	....
Main service and panels	1,163	....	....
Wire and fittings	1,012	22	....
Hand-ball court wiring	310	....	....
Other expense	273	....	....
	$6,304	$297	4.3
Equipment—			
Elevators and paper lifts	$11,836	....	8.1
Lighting fixtures	2,084	....	1.4
Venetian blinds	1,431	....	1.0
	$15,351	....	10.5
Total contract amounts	$145,943	$1,893	100.0
Extras	$1,893		
Total of building contracts	$147,836		
Architects' fee 5% of above	7,392		
Total of cost of building	$155,228		

Total contents, 486,610 cu.ft.; cost per cu.ft., $0.304.
Cost per cu.ft. including architects' fee, $0.32.
Extras 1.28% of total contract amounts.

Cost of hand-ball court—	
Contracts	$2,668
Architects' fee	233
	$2,901

Contents of hand-ball court, 10,450 cu.ft.; cost per cu.ft., $0.278.

Construction Costs on Transmission Line and Steam Generating Station

THE following tabulation of cost data covering transmission line and steam generating plant construction, speaks for itself. Figures were furnished by the Pennsylvania Water and Power Co., Baltimore, Md., under date of Aug. 19, 1927. Attention is directed to the fact that in the transmission line job, overhead charges are included in the cost per mile and per tower. The steam generating plant figures, however, do not include overhead costs.

TRANSMISSION LINE COSTS PER MILE AND PER TOWER
(Including Overhead)

	Pennsylvania		Maryland	
	Per Mile	Per Tower	Per Mile	Per Tower
Right-of-way surveys	$323.00	$46.00	$321.00	$36.00
Tower location	78.00	11.00	154.00	15.50
Tower structure (at location)	3,924.00	554.00	931.00	676.00
Foundation material	721.00	102.00	702.00	85.00
Making foundation	636.00	90.00	951.00	103.00
Assembling towers	464.00	66.00	1,090.00	111.00
Hardware and insulators (at location)	1,790.00	253.00	1,458.00	153.00
Erecting insulators	36.00	5.00	45.00	4.75
Cable material (at location)	3,191.00	451.00	1,665.00	184.00
Erecting cables	441.00	62.00	539.00	57.00
Clearing, tree trimming, etc.	786.00	111.00	1,163.00	136.00

STEAM GENERATING STATION COSTS PER CU.YD.
(Excluding Overhead)

	Excavation	Backfill	Concrete Reinforcing	Mass
Steam station structure	$3.24	$0.49	$38.94	$12.12
Boiler foundation	2.95	.....	21.89	.....
Turbo-generator foundation	2.22	.....	.....	19.66
Conduit trench	2.97	1.29	.....	.....
Filtration plant structure	4.73	1.66	40.69	.....
Cable vault	9.71	.....	43.57	.....
Intake and discharge tunnel	4.76	.....	22.77	.....
Coal transport system	1.87	.....	.....	32.86
Coal preparation plant structure	2.85	.68	24.59	.....
Coal hopper pit	3.99	.79	20.24	.....
Roof drainage	3.92	.60	.....	.....
Sewer tunnel structure	4.80	.38	29.81	.....
Ash sluice	.....	.....	33.91	.....
Turbo-generator platform	.....	.....	39.09	.....
Transformer platform	.....	.....	16.46	.....

This Week's Contracts—With Comparisons

Minimum costs observed are: $15,000 for water-works and excavation, drainage, irrigation, levee, river and harbor projects; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, institutional, religious and other buildings.

Week ended	Public Work	Private Work	Total U. S.
December 8, 1927..	$19,353,000	$55,596,000	$74,949,000
December 1, 1927..	28,773,000	68,667,000	97,440,000
December 9, 1926..	21,088,000	25,913,000	47,001,000
Jan. 1 to date			
1927	1,199,841,000	1,848,470,000	3,048,311,000
1926	1,041,184,000	1,697,471,000	2,738,655,000

E.N.-R. Index Numbers

On December 1, 1927

COST	VOLUME
203.90	272
Last Year 210.80	Last Year 211

The Index Numbers are published in detail and with charts in the first issue of each month. The Cost Index is given in full from 1903 through 1926, with a thorough explanation of its method of computation, and a graphic comparison with many other index numbers, in the 48-page pamphlet entitled Engineering News-Record Construction **Costs.**

Weekly Construction Market

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, per 100 lb....	$3.34	$3.75	$4.00	$3.10	$3.35	+$3.95	$3.00	$3.00	$4.00
Structural rivets, per 100 lb....	5.00	4.00	4.75	3.60	3.85	4.64	+5.75	5.25	5.50
Reinforcing bars, per 100 lb....	3.24	2.99	2.75	2.50	2.87½	3.77½	2.95	3.00	3.57
Steel pipe, black, 2½ to 6 in., lap weld, discount from list	48%	40%	54%	51%	48%	41%	42@53.8%	48%	.....
Cast-iron pipe, 6 in. and over, per net ton.....	—38.60	34.50	52.00	—34.60	40.50	52.00	48.50	53.00	41.00
Concreting Material									
Cement, without bags, per bbl. .	—2.25@2.35†	2.45	2.05	2.05	2.22	2.85	2.51	2.65	1.41
Gravel, ¾ in., per cu.yd.....	1.75	.....	2.38	2.00	1.25*	1.90	1.80	1.25	1.50*
Sand, per cu.yd.	1.00	1.75	2.00	2.00	1.25†	1.00	1.40	1.25	1.35*
Crushed stone, ¾ in., per cu.yd...	1.85	.....	2.83	2.00	1.25*	2.50	1.70	2.50	2.00*†
Miscellaneous									
Fir, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.	.....	.....	.....	39.50(S&B)	36.75 @ 8.75	—33.75	27.00	24.00	50@55
Pine, 3x12 to 12x12, 20 ft. and under, per M.ft. b.m.....	+60@62†	34.00	56.00†	.....	.....	.....	.....	.....	.....
Lime, finishing, hydrated, ton...	19.45	21.50	19.00	20.00†	25.50	24.00	27.50	24.00	21.00
Lime, common, lump, per bbl ..	2.35@2.50‡	1.25	1.82	1.50†	1.70	2.70‡	1.70	2.80‡	10.00*
Common brick, per M	—16.00@17.00†	11.50	13.60	12.00†	13.75†	8@12	—13.00	14.00	20.25
Hollow building tile, 4x12x12, per block.....	.....	.068†	.103	.....	.072	.085	.....	.10	.10
Hollow partition tile, 4x12x12, per block.....	.0966	.068†	.103	.076†	.072	.085	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.....	.79½	.84	.85	.83	.87¾	—.87	.84	.98	.93
Common Labor									
Common labor, union, per hour.	.90⅝	.30	.....	.90	.....	.....	.50@.60	.70	.....
Common labor, non-union, hour.	.....	.25	+.40@.50	.82½	.45@.60	.31¼@.50	....	.62½	.30@.35

*Ton. †Delivered to job. ‡280-lb. net. +Advance. —Decline.

A COMPARISON of current prices in the principal cities, with those in effect two weeks ago, shows strong upward tendencies in steel structurals, rivets, and long-leaf yellow pine timbers.

The movement is seasonally downward, however, in cast-iron pipe, portland cement, and common brick. Western fir prices do not appear to hold with the same tenacity as that manifested by quotations on Southern pine.

Linseed oil is 87¾c. per 7½-lb. gal. at Minneapolis; this price prevailed during the week of Nov. 24. The flaxseed market continues quiet.

The common brick situation attracts particular attention, at this time, because of the possibilities of change in market conditions due to the sudden advent of freezing weather.

Present downward tendencies of brick prices in northern cities will probably give way to firmer quotations as ice begins to impede movement of this material in the Hudson River district and along other water routes.

Four times as many brick-making plants throughout the country are now closed down, owing to unusual slackness in demand, as were idle at this time last year.

Despite an increase of 57 per cent in brick shipments from yards, compared with 1926 levels, a 15 per cent decline in orders booked, leaves 95 per cent more burned brick on hand than were available one year ago.

Common brick quotations at yards, show an average for the United States, of $10.68 per M. low and $13.65 high, as against a low of $11.76 and high of $14.55, in 1926.

An upward movement in the market for non-ferrous metals follows closely the recent advance in quotations on the three principal hot-rolled steel products. Bars, shapes, and plates, base, Pittsburgh, are $1.80 per 100 lb. in large tonnages, with a range of $1.85 to $1.90 per 100 lb., f.o.b. Pittsburgh, applying on smaller lots. The price was $1.90@$2 per 100 lb., at this time last year.

THIS limited price list is published weekly except in the first issue of each month and gives current prices on the principal construction materials in the chief cities. Valuable suggestions on costs of work can be had by noting actual biddings as reported in the Construction News and Unit Prices sections following.

The first issue of each month carries complete quotations for all of the basic materials and for the rest of the important cities, also wage rates for the principal building trades and common labor. The last complete list will be found in the issue of Dec. 1, the next on Jan. 5. Explanation of prices contained in the table will appear from time to time in this section; last shown Nov. 17, 1927, p. 820.